ADP

MARKET FORECASTING · ORDER HANDLING · ACCOUNTING · FINANCIAL AND COST CONTROL · DELIVERY SCHEDULING · STOCK CONTROL
AUTOMATIC MACHINE CONTROL · PROCESS CONTROL · DATA LOGGING · PRODUCTION CONTROL · RESEARCH AND DEVELOPMENT

A SMOOTH-RUNNING SYSTEM FOR £10,000,000 OF MOTOR SPARES

Getting a Feasibility Study under Way

How Much Can Machines Learn?

John Bolton: Live Wire in Electronics

Today's Challenge to Managers

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AUTOMATIC DATA PROCESSING

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Comment

Wanted: Intelligent Action

THE British people have often prided themselves on possessing a genius for 'muddling through.' We sought comfort from it during the anxieties of the thirties, when widespread unemployment and the crescent threat of war persuaded even the most complacent that all was not well; and it gave us confidence when the inevitable war came, long before we were armed and ready for it.

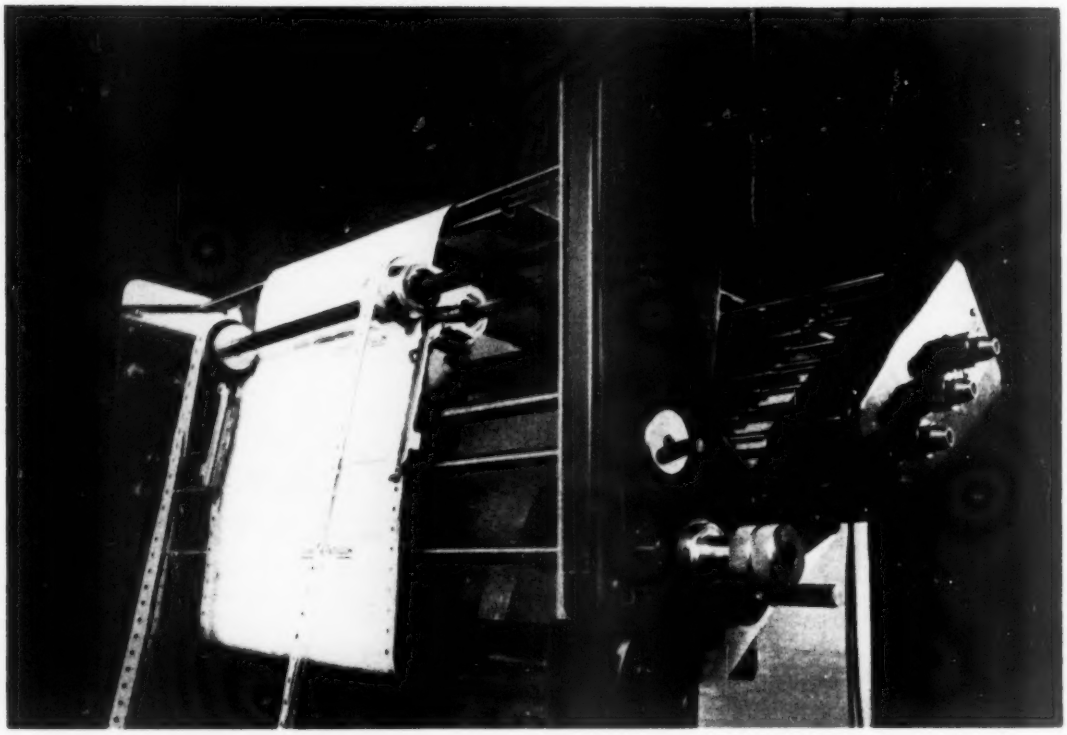
We have heard less of this native genius during the past five years, after a somewhat late recovery from the wartime austerities. Instead, we have been repeatedly reminded, in a distressingly brash slogan, that 'we have never had it so good.' In the prevailing Panglossian mood, one naturally assumes the rôle of Cassandra with reluctance: but timidity is indefensible and the awkward question must be asked: Are we still only muddling through, and is our good luck going to hold?

The question is especially pertinent in relation to automation, and nowhere more pertinent than in the sphere of managerial techniques. Among all the prophecies —some of them already platitudes—that are published about the new industrial revolution, is there really any clear vision of the future or even adequate knowledge of present facts? John Diebold, writing of the United States, has said: 'Until the facts are known, unfounded prophecies and unsubstantiated courses of action will continue to dominate the picture given to the public.' * That is as true of Britain as it is of America.

The need for a comprehensive and continuing study of automation and its economic and social effects is obvious. Equally obvious is the need for an honest examination of the present state of managerial techniques and policies, and for an appraisal of their adaptability to rapidly changing conditions.

It is neither fair nor sensible to ask commercial firms to carry the whole load of the 'management burden.' Government alone is in a position to assemble the information and to offer the policies on which a progressive and healthy economy must be based. The appointment of a permanent commission, working in close liaison with committees representing the nation's leading industries, would seem now to be an essential first step. But only a first step. Information is only the raw material of intelligent action, and we need intelligent action to guide the progress of automation. Industry has invested large sums in the development of automatic techniques and in so doing has laid the foundations for the continuing growth of the British economy. If the superstructure is to stand up, Government must lead, organise and co-operate with industry in working out effective policies.

* John Diebold: AUTOMATION: ITS IMPACT ON BUSINESS AND LABOR. Pamphlet No. 106. National Planning Association, Washington, DC. May 1959. One dollar.



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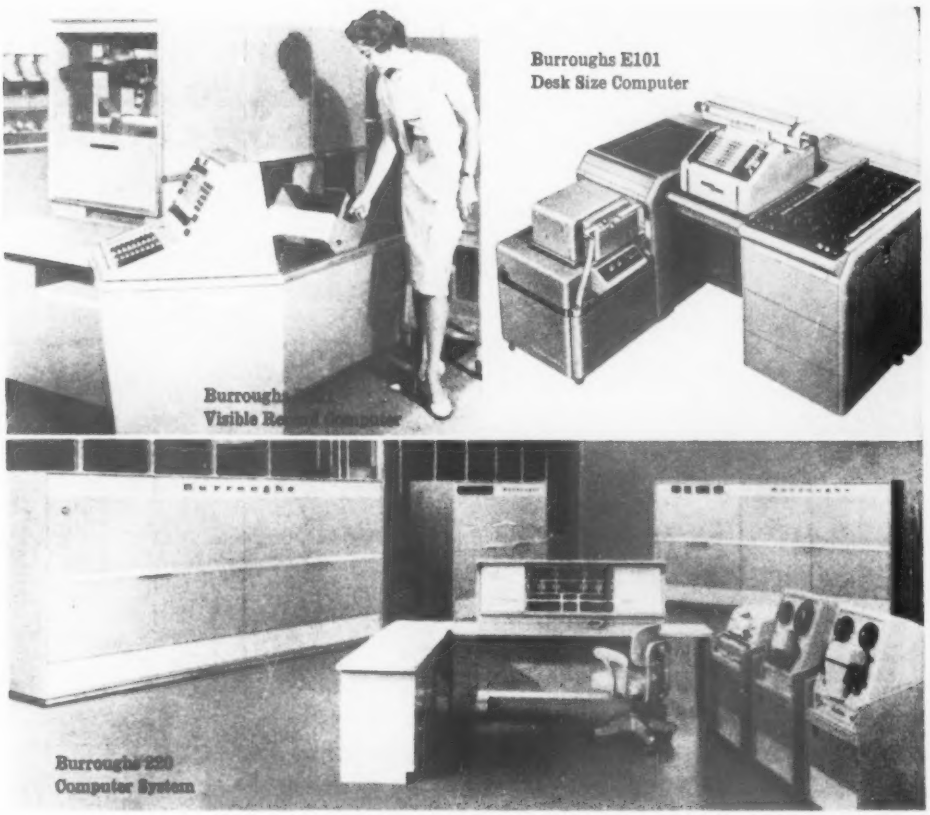

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A System for a £10 Million Inventory

Daily to a centralised depôt holding 65,000 motor vehicle spares valued at £10 million come 10,000 orders from 6,000 dealers in 163 countries. How are they handled?

Ronald W Wilcox

WHEN it was decided to centralise the Parts Division of the Rootes Group—hitherto operated from Luton, Coventry and from hangars on the former aerodrome and post-war motor-racing track at Silverstone—the management of Rootes Motors (Parts) Ltd was faced with the problem of providing an efficient system capable of processing 10,000 orders from all parts of the world every day.

The problem was a somewhat complicated one because the motor parts dealt with by the company for Humber, Hillman, Sunbeam and Singer cars, Commer and Karrier commercial vehicles, range from the smallest tab washer to complete body shells. All kinds of transport are used, there are different methods of delivery (either to the customer's premises, or collection being made by the customer himself) and there are different grades of priority to be given to delivery or despatch.

SIZE OF THE STORES

An idea of the size of the new stores, which were officially opened in 1959, may be judged from the fact that it took two years to transform the 18-acre Singer car factory, in Birmingham, into a parts division. The interior of the factory was completely renovated. Car production tracks were torn out, high-speed gravity shutes were constructed to complement seven large cargo lifts, linking all floors in the main building, and new offices were built.

The stores extend over 500,000 sq. ft. of covered floor space and the stock consists of 65,000 different motor vehicle parts, worth approximately £10 millions. The stores depôt consists of a main five-storey building and two single-storey blocks, but careful planning has obviated any difficulties this arrangement might have presented. The slower moving items of stock are accommodated on the top floor of the five-storey building and parts in greater demand are on the lower floors.

SPEEDY DELIVERY

The new depôt enables the company to speed up the delivery of spare parts to the 6,000 dealers in 163 countries—an important factor in a keenly competitive industry. Approximately 40 percent

Rootes Motors (Parts) Ltd.

HOME PARTS ORDER

ROUTING SHEET

1

Main Dealer Rootes.Limited.
Birmingham.

Despatch to

HOME SALES

Reg. No. 104/1/1/161

Folder No. 1987

No. of Items 1

Date to Stores 19-11-59

Cartons charged

Post charges

Gasket Boards

Case details

Despatch Details

Post		Group Transport	
Pass		Road	
Goods		Collect	19-11-59

Method of Despatch and Date

Form No. 60000

Figure 1. The pre-printed routing sheet used for parts orders from the home trade

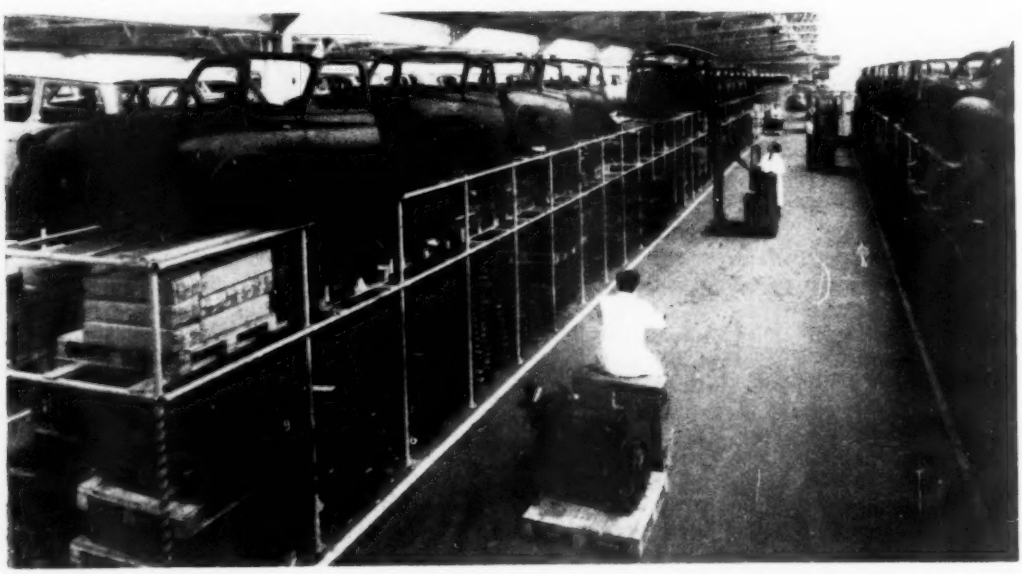
of the output of spare parts is exported to supplement the large stocks carried by Rootes-owned companies, distributors and dealers throughout the world. Reflecting the importance of the European market, four new Rootes-owned parts depôts have been opened in France, Switzerland, Belgium and Germany.

The central depôt is linked closely with many main parts stockists by the Telex system. The depôt has its own Telex station and is daily receiving Telex orders within minutes from centres such as Toronto, Montreal, Vienna, Geneva, Malmö, Stockholm, Helsinki, Copenhagen, Dublin, The Hague and Paris, as well as from the home market in Britain.

10,000 ORDERS DAILY

Out of the 10,000 orders received daily, up to 1,000 are urgent, involving air freight despatch, passenger train despatch and are very often wanted for collection by the customer within a few hours. With this in mind, a flexible order

Modern mechanical handling equipment is brought to bear to speed spares that range from body shells to tab washers on their way to the dealers



The card bank at the central depôt holds some 750,000 cards pre-punched with constant data

processing system had to be devised, and the installation includes both Hollerith and National Cash Register machines. This equipment deals not only with the preparation of orders for despatch, but a wide variety of daily, weekly and monthly programmes required to maintain the statistical data on which provisioning, sales and market research, etc, are based.

Dealers' orders are received by the home and export sales offices and there they are categorised as follows:

(a) Urgent (home);
(b) Urgent (export, involving air freight);
(c) Ultra urgent (customer waiting to collect);
(d) Normal (monthly stock replenishment orders);
(e) Supplementary.

The procedure described in outline mainly concerns the routing and processing of monthly stock orders, but is applicable, with variations, to other types of orders.

PROCESS CONTROL DEPARTMENT

From the sales department, the order is passed to the process control department and a pre-printed routing sheet (Figure 1) is compiled, bearing the information which will be required by the stores section, ie, the customer's name and order number, number of items, folder number, and method and date of despatch. On home orders this routing sheet is a relatively simple document, but the export equivalent is somewhat complicated by the special licence details, packing instructions and symbols, etc, which are required in various parts of the world.

At the beginning of each six-month period, dealers in the home market are advised of both the submission and collection or despatch of their stock orders, and the individual compiling the home routing sheet simply refers to a programmed schedule for collection or despatch, unless the dealer has requested other specific consignment instructions.

ORDER TO CARD BANK

The next stage in the process is for the order to be passed forward to the card bank. This bank carries approximately 750,000 cards which are pre-punched with constant data, ie, location number, part number, abbreviated description, unit retail price, unit of issue and discount code. The cards are further identified by different edge colours, and as an example, a dark green-edged card denotes that a purchase tax card (edged in red) is applicable and must be used in respect of all home market demands. A further example is that a home order with a special discount is indicated by a blue-edged card and carries an

ROOTES PARTS DIVISION
BIRMINGHAM

BIN NO.	PART NO.	DESCRIPTION	UNIT OF ISSUE	UNITS ISSUED	REGISTRATION No.
107780	J220366	Engine unit	each	001	106 /1'1'080

ROOTES PARTS DIVISION
BIRMINGHAM

BIN NO.	PART NO.	DESCRIPTION	UNIT OF ISSUE	UNITS ISSUED	REGISTRATION No.

Figure 2: A stores selection document

equivalent yellow-edged card for use in respect of export demands, and a plain-edged card denotes that it may be used for either home or export markets without discount variation.

LEADER CARDS

The first card to be picked against each order is a leader card which is pre-punched with the constant code number applied to the dealer. This must always be the leading card and, following behind it, a card is picked for each line item required by the dealer. A mark-sensing technique is used and the leader card is, first of all, marked with the remaining five digits of the eight which comprise the customer's registration code number (three), type of usage (one), type of order (one) and progressive dealer's order number (three). Following behind the leader card, each part number card is marked with the quantity required.

MARK-SENSING

At a specific time each day, the packs of cards are passed to the Hollerith machine room where they are mark-sensed and gang-punched on a mark-sensing machine. The first operation of the machine is to punch into the leader card the five digits which have been mark-sensed in, and then the total of eight digits is gang-punched into all the following cards until the next leader card passes through. At the same time the individual quantities marked on each card are automatically punched in.

STOCK BALANCE CARDS

After mark-sensing has been completed, miscellaneous cards, ie. leader cards, purchase tax cards, surcharge cards, etc, are out-sorted, the main pack is sorted into part number sequence and a list is produced. The list is then passed to the National Cash Register section where a stock balance card is maintained for all items held within the factory. Where stock is available, the item is posted off the card, but no posting action is taken in respect of those parts which are not available immediately.

On completion of posting, the cards relative to items endorsed 'out-of-stock' are manually extracted and the cards for available items are returned to the Hollerith machine room. These are sorted into bin location within registration number and a stores selection document (Figure 2) is produced. This document is printed with the following information—bin number, part number, description, unit of issue, units to be issued and full registration number.

STORES DOCUMENTS

The stores document is a three-part form and each section can contain up to a maximum of 11 items. The top two copies are perforated at each 11-item stage, but the third copy is perforated for each part number. The top copy is the dealer's advice note which accompanies the goods, the second copy is returned to the process control department and the third copy is split down by the selector, the slip being attached to one off each part number of the consignment for identification purposes.

As will be seen, the dockets for any one dealer are in floor- and bin-location sequence, the first digit of the bin number representing the number of the floor or separate block. As stated earlier, there are two other blocks apart from the main five-storey block, and these are referred to as the sixth and seventh floors.

COLLATING DOCKETS

The dockets to each order are placed into folders with the accompanying routing sheet and passed to the stores for selection and despatch, etc. The outside of the folder is endorsed with

'The depôt has its own Telex station and is daily receiving Telex orders within minutes from centres such as Toronto, Montreal, Vienna, Geneva, Malmö, Stockholm, Helsinki, Copenhagen, Dublin, The Hague and Paris'

the number of items contained in the folder and also with the number of folders relating to each consignment. This ensures that no part of the order will be despatched before all the floor folders are married up in the despatch area.

WORK IN PROGRESS

Whilst the folders are being prepared, two further operations are being carried out in respect of the punched cards. All cards for both available and non-available items are calculated and the available cards are retained in the same sequence as the stores dockets were produced, ie. location within registration number, and passed back to the process control department to be filed as 'Work in Progress.' Export cards are calculated at retail and home cards at nett. The cards are not handled again until the folders relative to them are returned from the stores.

STORES ISSUE DOCKETS

When the folders are received by process control from stores, they contain the second copy and the original stores issue docket and also the routing sheet. The latter is endorsed with the actual despatch date, method of despatch, any postal charges which are involved, and also details of any packing cases which are used in the consignment.

The second copy of the stores issue document, as mentioned earlier, is not split individually, but retained in sheets up to a maximum of 11 items per sheet. These are then re-checked against the cards from which they were originally produced.

If an item has not been despatched due to physical non-availability, or a quantity has been reduced, the card is extracted for processing through the out-of-stock procedure. When the cards have been checked, they are returned to the Hollerith machine room and re-sorted to part-number sequence and invoices are prepared from them. In the case of export, the cards are sorted to part number within packing-case number.

INVOICES

At the same time as the invoices are produced, the invoice total is summary-punched into a separate card which goes forward at the end of the month for compilation of the sales ledger. The second copies of the dockets which detail the signature of the selector, checker, packer and invoicing clerk, are dead-filed for a period of two months, pending any complaint of under-delivery or incorrect shipment by the dealer.

OUT-OF-STOCK CARDS

The out-of-stock cards are sorted into full registration sequence and name and address cards are inserted for each order number. They are then used for the purpose of producing an 'Out-

OUT OF STOCK/SUPERSESSION NOTIFICATION

ROOTES MOTORS (PARTS) LIMITED
COVENTRY

1

TELEGRAMS: "HUMBER, COVENTRY"
TELEPHONE: 3544

Messrs Rootes,Limited,
Birmingham.

ALL COMMUNICATIONS TO BE ADDRESSED TO THE COMPANY AND NOT TO INDIVIDUALS

REGISTRATION NUMBER	PART NUMBER	DESCRIPTION/SUPERSESSION NUMBER	UNIT OF ISSUE	QUANTITY
1J6/1/1/010	W 18956	Shaft - cam	each	001

Figure 3: Out-of-stock cards, sorted into full registration sequence, and with name and address cards inserted for each order number, are used for producing 'Out-of-Stock/Supersession' forms, copies of which are passed on to the customer

of-Stock/Supersession' form (Figure 3), a copy of which is passed to the customer. This document, used by the customer in conjunction with either the top copy of the stores document or the invoice, covers all items originally demanded by him.

SUPERSEDED ITEMS

The same form also covers items which have been superseded and there are two alternatives which may arise. If, for example, a customer orders part number 1 and it has been superseded by part number 2, the latter not being immediately available, the 'Out-of-Stock' form will show part number 2.

In such cases, the sales office will write to the customer and advise him of the supersession. If, on the other hand, part number 1 is out of stock and at that point is not subject to supersession, the 'Out-of-Stock' form will indicate part number 1.

Before stock becomes available on this part number, it is possible that it may be superseded by part number 2, in which case the dealer will receive the 'Out-of-Stock/Supersession' form, indicating that part number 2 now supersedes part number 1 and that he will receive the material under part number 2. All out-of-stock cards are classified by a punched hole and the 'Out-of-Stock/Supersession' form is produced from them.

DATE SEQUENCE

The original punched cards are filed in date sequence, but within two separate packs, the first relating to parts out of stock against urgent orders and the second to those applicable to stock orders. When material becomes available, out-of-stock parts against the urgent orders are released and despatched on a daily basis, but general out-of-stock parts are released to the stores, for selection with the appropriate routine sheets, on a weekly basis. It is at this point that out-of-stock parts are posted from the ledger cards.

An interpretation section is allied to the ledger section to deal with orders where no part number has been quoted by the dealer or the part number has been superseded, etc.

URGENT ORDERS . . .

As previously stated, normal monthly stock orders and supplementary orders are pre-listed in part number order, but to ensure that urgent orders are cleared within a maximum of 24 hours, they by-pass the normal system and are processed in a reversed manner. They are fed immediately to the National ledger cards, posted, and dockets are issued to the stores twice daily. A night shift is available in both the office and the stores for the clearance of these orders.

. . . AND VERY URGENT

In the case of ultra urgent orders for which a customer's transport is waiting, or other exceptional circumstances, these are ledger posted and dealt with through the punched-card system for internal reference purposes only. To expedite the issue of such orders, stores-issue documents are typed and not produced by the machine. The punched cards, however, are processed for internal purposes on the following day.

Urgent export orders are dealt with in the same manner, following normal routine up to the selection of punched cards from the bank, when a typewriter is used to prepare both the stores selection documents and also the advice note covering the despatch.

INVOICE CALCULATIONS

Calculations for invoicing purposes are carried out by a Hollerith 555 Electronic Calculator, and four double-alpha tabulators are utilised for preparing invoices, sales analyses and other tabulations and lists required by various departments.

SUMMARIES

Each day a total is struck of invoices, and detail cards equivalent to the invoices are sorted to produce an analysis of output. Summary cards continue to be produced for the production of tabulations at the month end. Cash cards, journal transfer cards and credit cards are all processed and a statement of accounts is provided for the customer, and a sales ledger for the accounts department. At the end of the month

The 'mechanised accounting' section of the spares depôt

complete analyses of all sales are categorised, ie. special accessories, service units, inter-company issues and normal parts are broken down into categories required by other departments.

It should be mentioned that both input and output values by dealer are produced to show geographical trends.

SUPPLY ANALYSIS

Immediately after the stores-issue dockets have been produced, the punched cards are reproduced and the reproduced packs go forward for supply analysis, ie. they are used for collating information, for buying and scheduling purposes.

Calculations are carried out by the 555 and are checked by the same medium. By these means it is possible to throw out for special review any items for which not more than eight weeks' stock is held. At the same time each week, provisioning department is supplied with a card showing details of all items which have moved within the previous week.

WEEKLY BALANCE CARDS

The 555 produces a new balance card each week for each item and for provisioning purposes, shows the accumulative usage for the year, current demand for the month, stock quantity, total stock quantity and total receipts for the current year. Into the same card is calculated and punched the stock value required by the accounts department.

The cards produced for the provisioning department are fully interpreted for filing, which obviates manual posting, and they are sorted into various buying sources and works sections by the Hollerith machine room to facilitate easier handling by the provisioning department.

The ICT 555 Electronic Calculator used by section

MAIN CARD BANK

One of the further important tasks of the machine room is the preparation of cards for the main card bank, and for this purpose a master retail card and a master replenishment card are produced immediately an item is added to the range. From the replenishment card, the bank is maintained. This particular card carries an orange-coloured edge and is inserted approximately in the middle of the part number pack within the main bank.

The cards against orders are picked from the back of each pack and when the operator reaches the orange card, it is extracted, passed into the machine room, is interleaved with suitable blank cards, which are then gang-punched and interpreted and the new pack returned to the card bank as replenishments. To indicate the usage of cards for a particular part number, the replenishment cards are date stamped following each extraction.

ADDITIONAL MACHINES

In addition to the 555 and the four Double-Alpha tabulators, there are five gang-punch mark-sensing machines in the machine room, which are used for mark-sensing, reproducing, summary punching, etc. There are three interpreters which read the holes and print the interpretations across the top of the cards, four sorters for sorting the cards into any particular sequence required, three collators which are used for sequence checking and collating more than one pack of cards, and two balancers.

For each tray of cards going into the machine room an opening balance is always rendered, and at the end of the main operation a further balance is struck, the two being reconciled before either the cards or the tabulation, etc, produced from the cards, is issued from the machine room. Control registers are in operation at all main points and a strict control is maintained over all cards, lists, tabulations, and other paperwork both entering and leaving the department. Hand punches are used for the purpose of producing miscellaneous cards, ie. master cards, goods receipt cards, etc, and a key-stor punch and electric verifier also form part of the Hollerith machine room equipment.

The system at the Rootes Parts Depôt has been extended or modified in the light of experience. It has worked well, but in an industry that is constantly seeking to better its methods, the management are always examining ways of improving it.

Off the Mark to a Feasibility Study

The second article in this series, on aspects to be weighed before deciding if a computer is worth while, outlines how to organise for a feasibility or justification study

H W Matthews, *Urwick Dir'ol't Limited*

THE first article in this series provided some broad criteria for assessing the desirability of studying the applicability of automatic data processing. Should consideration of the criteria indicate that a study appears to be worth while, the next step will be that of setting about and organising for the study—a phase covered by this article.

Setting about a feasibility study frequently takes more time than is generally realised. Several companies in Britain have spent more than a year in preparing to make such a study, and postponements and long delays are the rule rather than the exception. Often it is difficult to find the right people to make the study, and even when they can be found it is not always easy to obtain their release from their existing duties. The main problems, however, are the overcoming of the natural inertia and the difficulty of creating a suitable climate for a fruitful study. Getting the ADP study under way and ensuring its continuing progress according to plan are problems of organisation and planning.

STEPS TO A QUICK START

Here are some steps that can provide a quick start to a study programme—the steps are based on a full-scale study. (In cases where fulfilment of the criteria is marginal or where other factors make the feasibility of ADP doubtful, some alternative preliminary steps may be taken as described later.)

1. Appoint one individual to have full responsibility for the study

The man appointed should be (as has so often been said) a paragon with all the virtues of a manager, diplomat and technician. Such men are indeed rare and where they exist they are usually already occupying key executive positions. It is important to have as good a man as possible and particularly he should:

(a) Have intelligence and the ability to deal with people.

(b) Have company background and be thoroughly familiar with the organisation.

(c) Be high in the organisation. His position should be such that if he is subsequently appointed manager of ADP it will not represent too great a promotion for him.

DETAILED KNOWLEDGE NOT ESSENTIAL

A detailed knowledge of computers or ADP is not a pre-requisite for the job; but a systems background is most desirable. Every effort should be made to find such a man from within the organisation, for if the man to lead the study effort is recruited from outside there may be problems of acceptability. Also a problem may arise later on what to do with him if the finding of the study lead to a decision not to proceed further. However, if a suitably qualified individual is not available in the organisation it is far better to recruit a good man from outside than to appoint a mediocre man from within the organisation.

2. Provide terms of reference for the study

Right from the start the man responsible for the study should know the objectives and the areas to be covered during the study. He should be told the basis for justification—whether, for example, clerical savings alone are to be the criterion or whether intangible benefits can also be considered. The areas to be included in the study (functional or organisational) should be clearly defined. A company may for instance decide not to extend the study to payroll or it may wish to exclude semi-autonomous areas or divisions.

Proper terms of reference, however, will usually include virtually all data processing activities, and if that is the case it should be clearly stated—emphasis can, however, still be placed on specific points.

Perhaps one of the most effective ways of developing appropriate terms of reference is to have the team leader draft them in the first place. The draft can then be reviewed, modified and approved by general management.

3. Provide training or orientation for the study team leader

Although the team leader need not be a computer expert, by any means, he should have some knowledge of ADP with particular reference to:—

(a) Potential or promising uses of ADP.
(b) Pitfalls and difficulties that may be met.
(c) A realistic notion of the costs and work involved in an ADP programme.
(d) Methodology for a feasible study (so that he can draw up intelligent plans and schedules).

PLANNED PROGRAMME

A carefully planned training or orientation programme of about six to eight weeks' duration should be adequate, provided it is followed by a continuing activity of self-improvement.

If, however, a study team leader is appointed from outside, sufficient time should be allowed for company orientation. This orientation may well take longer than two months for it is a two-sided process—the man has to get to know the company and his colleagues have to get to know him.

4. Develop a definite schedule with intermediate deadlines

It is not enough to decide the length of time that the study should take from the time of the decision to undertake it. As in any other effective schedule, intermediate goals must be set if control is to be exercised effectively. Providing a clear and definite schedule with the responsibility for its execution resting squarely on one man is one of the best ways of ensuring that the work will be done properly and on time.

Obviously the man with this responsibility should also have the necessary support in the way of time, funds, staff and authority.

It should take the study team leader, after he has been trained and orientated, only about two to three weeks to develop the required detailed schedule. Incidentally, the tendency usually is to underestimate the time required for a project of this nature so that what appears at first to be a loose schedule will often finish up by being tight.

PHASES OF SCHEDULE

The schedule should provide for the following phases:—

(a) Selecting the study team members and obtaining their release.
(b) Training the study team members as necessary.
(c) Engaging any new staff that may be required. (This and the two previous steps may be carried out concurrently with the training or orientation of the team leader.)
(d) Performing the study, with a target date for each phase or aspect of the work. (A sample schedule is exhibited.)
(e) Preparing the report.

5. Select the study team

If the study team leader is qualified to do so he should be allowed to select his own people, subject, of course, to the overriding needs of the rest of the organisation. In this matter, management must be prepared to give a good deal of support in an endeavour to ensure that the team is staffed with the most suitable people.

6. Appoint and orient a review group

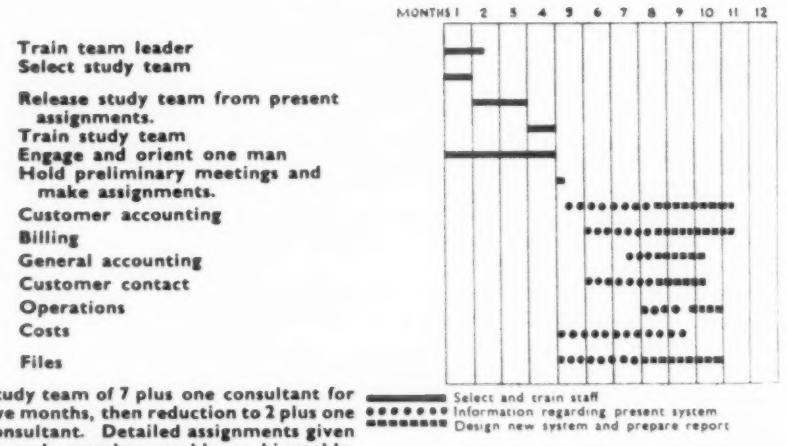
The review group can and ought to be a most effective body if it is operated correctly; but if it isn't it can represent a major obstacle. Some of the functions of the group are:

(a) To receive the interim reports produced by the study team.
(b) To consider progress.
(c) To give guidance to the study team.
(d) To consider and advise on future actions.
(e) To make final recommendations to the Board.

ADVISORY ONLY

The review group should be advisory only and the executive to whom the study leader reports should be the chairman of the group. The group should consist of members of top management and, depending on the size and structure of the organisation, each major department or division might be represented.

SCHEDULE FOR LARGE FEASIBILITY STUDY
(public utility)



* Study team of 7 plus one consultant for five months, then reduction to 2 plus one consultant. Detailed assignments given to each member weekly or bi-weekly.

In the early stages of the study, excessively frequent meetings of the review group are to be avoided. For some weeks there will be comparatively little to report and there is a danger that the study team will spend too much time preparing interim reports which are likely to contain only tentative thoughts.

Needless excitement can be caused if the review group is exposed to ideas that are changed later in the study. On the other hand, as conclusions become fairly evident it may be desirable to increase the frequency of the meetings to gain support for an acceptance of ideas. Generally, it is adequate to hold meetings every four or five weeks.

ORIENTATION PROGRAMME

When the review group is first appointed it is good practice to provide a brief orientation programme for its members. Subjects covered should include a general introduction to computers and the concept of ADP and a special session should be devoted to the objectives of the feasibility study.

7. Proceed with the study

Progress should be reviewed frequently to assess performance against the plan. It will undoubtedly be necessary to revise the schedule from time to time, but revisions should not be decided on too lightly.

A study that involves the preparations that have been outlined above is obviously fairly elaborate. For a smaller company the same steps will still be necessary, but it may be possible to reduce the time factor so that the study may take only two or three months. Also, the study team may be smaller and may well consist of only the leader and one other individual.

ALTERNATIVE METHODS

A company or organisation that is doubtful about the feasibility of applying a computer may not wish to undertake an elaborate study. In that case there are two preliminary alternatives that may help in making a decision, although neither is a substitute for making a proper study.

1. Obtain proposals from equipment manufacturers

It is obvious that the correct time to obtain proposals from manufacturers is after a thorough study has been made—only then can a company prepare a precise specification of what is required of the ADP system. Nevertheless, proposals made by equipment manufacturers can be of value, particularly when they indicate the potential profit areas. Also, the potential savings and estimated costs given in manufacturers' reports provide a pretty good guide as to whether there is any point in getting involved any further.

2. Undertake a brief preliminary survey

A man experienced in automatic data processing should be able to draw fairly valid conclusions as to possible savings, benefits and costs from a survey which takes only about six to eight weeks. Such a survey can also provide sufficient evidence as to whether the organisation, because of the nature of its structure and personnel, is ripe for ADP. Finally, a brief survey can reveal what fundamental steps must be taken in systems, methods, management and staff development before embarking on a detailed project. Either

one of the above alternatives may provide the facts needed for making a decision either to drop the matter or, alternatively, to undertake a detailed feasibility study.

SOME QUESTIONS

There are certain aspects of getting a study under way besides those already dealt with that give rise to questions. Here are some of the questions most frequently asked:—

1. How is the study team made up?

There are no hard and fast rules for determining the composition of a study team but the following requirements should be met:—

(a) The team must have a leader.

(b) Each major potential area of application should be represented. If, however, too large a team would be needed to satisfy this requirement, one man may represent two or more departments provided he is widely experienced within the company and his knowledge in each area is acknowledged by those presently there.

(c) One member of the team should be knowledgeable in computers and ADP. This can be achieved through training or by engaging a man from outside or by having a data processing consultant in the team. In this connection it is important to appreciate that knowledge of punched card methods and techniques is by no means the same as familiarity with ADP.

2. To whom does the study team leader report?

The essential thing is that he should report to one individual, not to a committee. As already mentioned, that individual may well be the chairman of the review group but there should be a direct line relationship between the team leader and the man to whom he reports, quite independent of the committee relationship. One of the best ways to ruin a study programme is to give the review group executive powers.

The executive to whom the leader reports should be high in the organisation and should be a member of general management rather than a departmental executive.

3. How much training should the team members receive?

The training of the team members need not be too intensive if one of the members is reasonably knowledgeable in ADP. Generally it is a good thing to have the members attend a computer appreciation course and perhaps a short programming course. Training should also be provided in some of the special techniques involved in an ADP study. The complete training need not take longer than four to five weeks.

4. What happens to the team after the study is complete?

It is advisable, in choosing the members of the team, to have some regard for the work that will follow a decision to have a computer. In a carefully planned and executed ADP project, one of the objectives will be to achieve a smooth transition from one phase to the next (feasibility study, system design, equipment installation, operation of the system). In aiming for a smooth transition the following will help:—

(a) The team leader should be able to assume the position of ADP manager eventually.

(b) The team members should be aware that additional people may be brought in later on from outside—eg a chief programmer.

ASSURANCES FOR THE FUTURE

It is also important that the study team members be given assurances as to their future in the organisation should the decision be made not to install a computer.

The tendency for them to identify their interests with a computer, as so often happens, is an extremely difficult factor to deal with. Good morale and enthusiasm can help the work, but sometimes they produce a dangerous bias.

Almost invariably, the early steps in any computer project are difficult ones. Giving one man the full responsibility for the study and then following up regularly on results has been found to be an effective way of overcoming the inertia that so frequently exists.

There are certain aspects of the work of performing a computer study that are different from those of normal systems work. These will be considered in the next article in the series.

A Glossary of Terms Used in Automatic Data Processing

Work is in progress on the compilation of a glossary of terms in current use in automatic data processing, to be published during the summer as a supplement to this journal. Experts in the various aspects of the subject are compiling lists of terms and writing definitions. Readers of AUTOMATIC DATA PROCESSING are invited to contribute suggestions for words and definitions which in their opinion should be included in the glossary. Envelopes should be marked 'Glossary' and addressed to:

The Editor: AUTOMATIC DATA PROCESSING
Mercury House, 109-119 Waterloo Road, London, SE1

Names and Notes by Robot

A Live Wire in Electronics

A PROSPEROUS new year for the electronics industry was implied in the announcement on 30 December that Firth Cleveland Ltd were to acquire 53¼ percent of the shares of the Solartron group. Behind the news is a heartening success story of the kind that we have grown accustomed to hearing, rather enviously, from across the Atlantic.

It is, as a matter of fact, a conjunction of two success stories. Both the principals are Wolverhampton men. Mr CHARLES W HAYWARD, chairman of Firth Cleveland, becomes chairman of the Solartron group and displaces Mr JOHN BOLTON, who becomes deputy chairman and retains his post as managing director. The amalgamation will provide finance for Solartron's next five-year plan of development.

EXCEPTIONALLY YOUNG TEAM

THE Solartron group has an exceptionally young team of directors and managers. The present chairman and managing director of Solartron Laboratory Instruments Ltd, which was founded at Kingston-on-Thames on 30 June 1948, is Mr E R PONSFORD, aged 39. Mr L B COPESTICK, chairman and managing director of Solartron Research and Development Ltd, is 47; and Mr J E CROSSE, chairman and managing director of Solartron Engineering Ltd, is 33. The average age of the entire managerial team is 35.

Mr BOLTON, at 39, is undoubtedly one of the live wires of the electronics industry in Britain. He was educated at Wolverhampton, Cambridge University and Harvard Business School, and joined Solartron in 1951.

The Solartron Electronic Group Ltd was formed on 23 June 1954. It then employed 240 people. Today it employs more than 1,300. Sales during the year ended 30 June 1954 were £152,000. During the year ended 4 July 1959 they were £2,107,000.

BRISK BUT RELAXED

RECENTLY I met Mr BOLTON at Farnborough, where the new Solartron factory and the group's headquarters are situated. I wanted to learn which of the group's proprietary products in the electronics field could be expected to make the most useful contributions to automatic data processing in industry. And I was, to be frank, curious about the personality of this young businessman and the dynamic group of companies he headed. I found him brisk, but relaxed, and in appearance not very much like published photographs of him.

Several distinct themes tended to flavour if not to dominate his conversation. One was the need for standardisation in the electronics industry and the complementary need to avoid wasteful duplication of effort in research and development. This calls for a more fluent exchange of information.

There was, he said, a scarcity of trained electronics engineers relative to the vast potential of the industry. He was clearly proud of the fact that Solartron had attracted several good men back from the United States.

FIVE-FOLD GROWTH PREDICTED

ALTHOUGH 20 percent of the group's manpower is engaged on research and development, 'we can only do about 10 percent of what we need,' he said, and reiterated that 'it is most important to avoid duplication in research.'

He spoke of the vast potential of the electronics industry. What did he think this potential was?

In 1953, he said, Solartron carried out a survey to estimate the growth of the industry in the next 10 years. They were led to expect a twelvefold expansion. 'We worked on a conservative estimate of a five-fold expansion,' he said. 'It will come mainly in automatic data processing.'

What would Solartron's contribution be to automatic data processing?

'We have not entered the digital computer field,' he said, 'but we have ideas, which we believe are ahead of the rest of the world, for a digital-analogue analyser.'

Input and output methods had not had enough attention, he thought. 'So we came up with the

electronic reading automaton (ERA) which we believe is unique. There will be many associated reading devices, using the same basic techniques.'

As for output, he thought Xerographic printing would mainly satisfy the demand, but later, for the industrial control field, Solartron were developing a high-speed alphanumeric printing device.

The other 'missing link' was in data recording. The group are producing digital data recording equipment and an analogue tape recording device under licence from the Consolidated Electrodynamics Corporation of Passadena, California. 'It will be used for recording vast numbers of channels of information from, for example, aircraft and missiles, or from various parts of industrial processes.'

NEW ERAS

In the factory I saw ERA in production. It has been developed to read cash register tally rolls, and Boots Cash Chemists have placed an order to feed information from counter sales direct to a computer. Co-operative societies are also planning to instal ERA machines. It may not be long, either, before football pool coupons are automatically read by ERA.

The reading of cash register rolls sets a very high standard of accuracy for the machine. 'The problem is not the reliable reading of normal printed characters but the necessity to allow for defective inking which produces very imperfect characters.' The machine applies about 200 criteria to each character.

ELECTRONIC WEIGHING

I saw an electronic weighing device which checks food packets and rejects underweight and overweight packets in different channels. The automatic rejection of *all* overweight packages can save a management large sums of money in a year.

SAKI, the Solartron Automatic Keyboard Instructor, more soberly described as a 'cybernetic teaching machine,' has a future in the construction of automatic computer programmes. 'The next stage is machines that do elementary thinking.'

BEER AND SANDWICHES

Over beer and sandwiches in the 'local' we returned to the theme of the shortage of electronic engineers and research workers. British universities should adapt their methods to modern needs, Mr Bolton thought. The lecturing technique was often a waste of time, especially when the lecture *preceded* private reading by the student. Harvard assigned individual case studies which compelled the student to read up and come to grips with relevant knowledge and techniques, a more practical approach. (British universities please copy?)

The Duke of Edinburgh

The Duke of Edinburgh will visit the headquarters of Leo Computers Limited at Hartree House, Queensway, Bayswater, London, and the company's laboratory and works at Acton on 22 March. He will be shown computers in production and experimental work on components and electronic circuits.

New Appointments

Mr Charles Evans, formerly BOAC fleet navigation officer for Britannias, and Mr Peter C Haines, formerly of the Ministry of Aviation, have joined the staff of the Air Traffic Management division of General Precision Systems Limited (formerly Air Trainers Link), at Bilton House, Uxbridge Road, Ealing, London, W5.

Mr D P Taylor has gone from Solartron, where he was sales manager for the western region, to join de Havilland Propellers Limited to assist in the sale of industrial and scientific electronic equipment.

Mr F B Chaventre has also joined de Havilland to handle sales to the process control industry.

How Much Can Machines Learn?

Many scientists are working on the problem of making digital machines act in the light of their own accumulated 'experience' instead of following detailed programs of instructions. Reporting on the progress they have made, Dr. Booth concludes that the surface of the problem has only just been scratched, though the modern high-speed computing machine opens up many possibilities.

Andrew Booth

IN the past two or three years much nonsense has been written concerning the supposed resemblances between automatic digital calculators and human beings, and this is particularly the case where authors seek to discuss the powers of machines to learn from experience. This article attempts to put the matter into perspective and to examine what has been achieved on digital computing machines and the way in which these achievements can find application in practice.

PAVLOV'S DOGS

Before discussing learning programmes for computers, it is worth while seeing the sort of learning which could easily be simulated on a machine. The psychologists tell us that the conditioning of a reflex, in the way first demonstrated by Pavlov on dogs, is in some sense a measure of the fact that a dog is an intelligent living organism. The way in which such a reflex is conditioned is probably too well known to need extensive description. Suffice it to say that to make a dog learn to respond in a given manner to an appropriate stimulus, it is either rewarded or punished a sufficient number of times after presentation of the initial stimulus and evaluation of its resulting action.

The classic example is that in which feeding was always accompanied by the ringing of a bell.

In due course it was found that the ringing of the bell on its own and without the presence of food was sufficient to produce salivation by the animal.

TEACHING A WORM TO TURN

In another series of experiments it was found possible to educate a worm always to turn either to the left or to the right. This was done by confining the worm in a T-shaped tube. If it made a turn at the junction in the wrong direction, it was punished by the application of an electric shock. It was then found that after about three hundred applications of the shock the worm was completely educated to turn in the appropriate direction.

REWARDS AND PUNISHMENTS

There has been considerable controversy as to whether training by reward or training by punishment or a mixture of both is most efficacious, although there seems no doubt in the case of human beings that training by punishment would be likely to produce more consistent results than the reverse.

An even more spectacular conditioning experiment has just been completed in the United States. The subjects were pigeons and they were trained to inspect a continuously moving set of transistors for sealing cracks. This they were able to do far more rapidly and reliably than were human beings, but, unfortunately, the labour unions have prevented this dilution of labour!

EDUCATING COMPUTERS

When the education of a computing machine is considered in the same light as that of the animal, a difficulty becomes immediately apparent. This is that a machine, from its very structure, has an almost perfect faculty for the learning and recitation of facts, always assuming that the correct programme is placed in its store.

This means, for example, that if a computing machine is required to 'learn' a poem, such learning can be achieved perfectly, supposing that an input programme is present in the machine which causes the poem to be recorded in the store, and that an output programme is also available so that the results of this recording can be typed out on a signal from the human operator.

BEGGING THE QUESTION

This, however, begs the whole question of machine learning, since the machine is simply doing what it has already been told to do by the human operator, and in this respect does not differ in principle from a typewriter upon which a human being records the poem which is then available for posterity to read as often as is desired.

THE SHOPPING MACHINE

The first published learning programmes for a computer were written by A G Oettinger[1] in 1952. They were on a slightly more sophisticated level than mere learning and repetition and probably the most interesting of his developments was that of a 'shopping' programme. In this there were recorded in the machine's store the names in code of a number of shops. Associated with each of these shops was a list, again in code, of the types of items which could be bought therein.

The education of the machine was as follows: the code number of a particular item was presented to it. The machine then proceeded to test each shop to see whether or not it sold the given item. If the desired item was sold by the shop, the next thing to be investigated was whether or not it was in stock.

SIGNAL TO OPERATOR

Now in modern computer usage in industrial and commercial organisations the question of stock would be decided by an internal stock valuation contained in the machine memory; in Oettinger's programme, however, the machine signalled when it arrived at a given shop to a human being who was operating the conditioning device.

If the item was in stock, an appropriate signal was given by the controller; if not, the reverse. In this way the machine was able to test a range of shops for a range of articles and to associate

Dr Booth first suggested the possibilities of machine translation of language and was responsible for most of the pioneer work in this field. The Computational Laboratory at Birkbeck College (University of London) gave the first demonstration of machine translation using punched card machinery in 1949, and thus forestalled the American demonstrations of the same type which were given in 1954.

Apart from the continuing interest in machine translation, Dr Booth's group at Birbeck College has been for some time occupied with investigations on computer simulation of learning processes, both in animal and human beings.

'A machine, from its very structure, has an almost perfect faculty for the learning and recitation of facts, always assuming that the correct programme is placed in its store'

availability of articles in its own store with the given shop code numbers. Thus, after a sufficient period of education, it was possible for the machine to go immediately to an appropriate shop when presented with the code number of the item desired.

PROGRAMME VARIANTS

As in real shopping, it sometimes happened that a shop became out of stock of a given item, and Oettinger's machine programme allowed for this also, so that if, after playing the shopping game for some time, the human operator decided that a given shop was to be out of stock of a given object, the machine would then search around among the remaining shops until an alternative supplier was located, and then use this supply until it too was exhausted. The variations on programmes of this sort are of course very numerous, but all follow the same general logical pattern and all, in the opinion of the present writer at least, contribute very little to a true understanding of learning processes in the human animal.

It is interesting to note that a programme for performing a shopping operation of the type just mentioned can be written with as few as seventeen computer instructions together with a number of storage locations appropriate to the number of shops and articles for which searching is designed.

AN EARLY PROPOSAL

The first published suggestion that the simulation of intelligent behaviour by a machine should make no assumptions regarding the machine's built-in structure appears to have been made by the present author in 1953.[2] The proposal was that the machine should be treated in roughly the same manner as a human infant. Signals for reward and punishment should be set up and in some manner these should cause changes in the contents of the machine's store, without in any way prejudging the results of the changes. Such alterations of the store contents could fairly simply be made either by means of a source of random numbers or by switching off the machine and assuming that when it is switched on again its storage device contains random numbers.

Although it was clear that such a training programme for a machine could fairly easily be tried in practice, a numerical investigation showed that significant practical trials were not feasible on the rather slow machines which were available in the early 1950's, and for this reason no experiments in the field were carried out.

CATEGORY COUNTS IN TRANSLATION

In the field of machine translation it soon became obvious that some means of machine learning would be required if ambiguities were to be resolved, and the group at Birkbeck College worked out a method, known as the method of category counts, to enable such a learning process to form part of a machine translation programme. The ideas behind this process were extremely simple and have in fact been mentioned in a previous article in this journal.[3]

In essence, in order to decide between various ambiguous meanings of a given word contained in a passage to be translated, all that is necessary is for each of the technical words contained in the machine dictionary to have associated with it one or more category numbers. These numbers, which form a sort of universal decimal classification, are typical of the fields of human endeavour which the dictionary contains; thus, for example, 1 = medicine, 2 = mathematics, 3 = physics, 4 = engineering, 5 = sociology, 6 = psychology, 7 = chemistry, and so on.

As each word in the given text is received by the machine, unity is added to the storage location associated with the appropriate category. Thus, after a number of text words have been processed,

it will be found that a large number of counts occur for the category of the main subject under discussion in the given passage, whereas fewer counts occur for all others.

RESOLVING AMBIGUITIES

When an ambiguous word is encountered, this will have several category numbers, each associated with one of the ambiguous meanings. To select the appropriate meaning, all that is necessary is to examine the category counts held in the machine store and to select among the ambiguous meanings that which is associated with the maximum category count.

Naturally a programme of this simplicity has many faults, particularly that if abrupt changes in subject occur ambiguities may be incorrectly resolved. Means are, however, readily available to take care of a situation of this sort; for example, two sets of category counts can be kept, the first a long-term one to cover the main subject, and the second a short-term one which is arranged so that at the end of each paragraph or even each sentence it is cleared to zero.

SUPERFICIAL RESEMBLANCE TO LEARNING

The important things to notice about mechanisms of this sort are firstly that they are conceptually simple, and secondly that, although they bear a superficial resemblance to at least some types of human thinking, they reveal nothing about the way in which a human being differs from an unthinking animal or from a computing machine.

FIRST PRACTICAL ATTEMPT

The first practical attempt to educate a machine without initial programming assumptions was made by R M Friedburg[1] in 1958, and an indication of the type of process involved will show how very far we still are from emulating the behaviour even of the simplest animal on a digital computer. Friedburg, using one of the most powerful IBM computers at present available, sought to make the machine produce a simple programme of its own without any assistance on the part of the human programmer. This was done by generating random numbers which could be interpreted by the machine as instructions.

A set of 64 such random numbers could be strung together and then tested to see whether the resulting programme performed the desired operation. Suitable criteria for reward and punishment were devised and with these the process of educating the machine was commenced.

The type of operation which the machine was to be taught was of the very simplest, for example: 'Transfer the number at the input of the machine to the output', and again: 'Generate the result of the logical operation "a and b" where a and b were the binary numbers zero and one.' In other trials the inclusive logical 'or' was the required operation, and again the logical operation 'not if, then.'

There is no need to discuss the underlying programming techniques which were used to produce the desired effect. The chief among them was a mathematical generator for pseudo-random numbers. The interesting thing is that a number of learning programmes were tried, each dignified by a pet code name. Two of the early ones were called 'Teddy' and 'Herman', and the results of the operation of these programmes are shown in the following table:

Logical Operation	Teddy		Herman	
	Trials	Successes	Trials	Successes
'and'	24,896	15	225,508	3
'inclusive or'	44,539	9	97,978	6
'not if, then'	18,633	8	141,306	3

VARYING EFFICIENCY

It will be noticed that the programmes differ in their efficiency, but that in any case a stupendous number of trials was required to produce even the simplest education. For example, nearly a quarter of a million to produce three successful repetitions of the logical 'and' function.

In the simplest programme, 'Transfer input to output' similar large numbers of trials were required. In this case six different types of learning process were attempted and the numbers of trials required to produce correct education are given in the following table:

Programme	Average number of trials for success
Samson	4,603
Herman	2,890
Teddy	1,360
Ramsey I	416
Homer	321
Ramsey II	60

Average number of trials for successful execution of the operation 'Transfer input to output'

It will be noticed that there are two versions of a programme called 'Ramsey' and that the final one is the most efficient. It is important to notice that there has been no question of manipulation in producing this final and not too disappointing result of 60 trials. All that was done was that a different interpretation of random numbers was used in 'Ramsey' final. This in no way, as far at least as a human being can judge, influenced the way in which the programme produced its final result.

'Although many things are possible for the modern high-speed computing machine, none of these as yet approaches the miracle of even the new-born human brain'

IMPORTANCE OF EXPERIMENT

The work of Friedburg is of great importance for our future understanding of possible educative processes for computing machines. It seems quite certain that vast numbers of repetitions will be required if machines are to learn on their own. Furthermore, our present understanding of the types of inbuilt unit logical operations which can lead most efficiently to learning on the part of the machine is at present very limited indeed.

It may be that the net of neurons which is present in the brain has logical properties which make learning a faster operation than was the case with the operations used by Friedburg and his collaborators, although a more likely explanation of the superiority of natural processes is to be found in the parallel operation which is made possible by the great number of neurons which are available.

IMITATING THE BRAIN

At the present time a number of experiments are in process in different laboratories to simulate the behaviour of such neural nets, but the difficulty with all of these is that they make some fundamental assertion regarding the way in which neurons interact with one another; for example, a typical case is one in which a neuron produces an output if more than a certain number of its inputs are simultaneously stimulated. Furthermore, the definition of whether or not a given input is stimulated depends upon the number of times that input has been used previously.

Using simulation procedures of this kind progress has been made in such things, for example, as causing a network of only a few hundred simulated neurons to remember in some sense a pattern which is presented to it, and to reply with a given output when this pattern is re-presented with a slightly different orientation.

CHARACTER RECOGNITION

One of the main incentives for work of the latter kind lies in the field of character recognition. Several *ad hoc* devices have been designed for this purpose and at least one is already in commercial production. These, however, appear to possess severe restrictions in that the recognition of characters which have quite small variations from the original type face may necessitate the complete redesigning of the system. Animals and human beings recognise type of different founts and in different orientations with ease and if such recognition is a function of their brain structure, it is to be hoped that by an investigation of idealised neuron nets the answer may be found to the problem of designing recognition machines of great flexibility.

These remarks have necessarily been of a somewhat superficial kind. Readers desiring more detailed information can examine the original papers which are mentioned at the end of this article. The general outcome, however, of all of this work is that the surface of the problem of machine learning has only just been scratched, and although many things are possible for the modern high-speed computing machine, none of these as yet approaches the miracle of even the new-born human brain.

REFERENCES

[1] Oettinger, A G: Phil. Mag. *43* (1952) 1243.

[2] Booth, A D and Booth, K H V, *Automatic Digital Calculators* (1st edn) pp 211-216. Butterworths, London, 1953.

[3] Booth, A D, AUTOMATIC DATA PROCESSING, *1* (6) (1959) 18.

[4] Friedburg, R M, *et al*, IBM J of research and development *2* (Jan 1958) 2, and *3* (July 1959) 282.

On The Track Of Lower Costs

In spite of extensive use of punched card and bookkeeping equipment, clerical costs at the Southern Railway Company (of America) continued to swell. Now with a machine to do a 'complete job' the tendency has been cut back.

THE South Carolina Canal and Railroad Company was founded in 1830 when only twenty-three miles of railroad track were in existence in the United States. Today, as the Southern Railway System, Southern Railway Company and its group of associated railway companies serve fourteen Southeastern states with a total of over 8,000 track miles. In keeping with its slogan of 'Serving the South,' Southern has invested some $450 millions in capital improvements since the second world war and by 1953 was the first major railroad to complete dieselisation. Southern also pioneered with electronic yard classification of freight cars, in the employment of mechanised methods for the maintenance of roadway and tracks, and in the utilisation of end-to-end radio communication systems for freight trains.

Southern was one of the pioneer users of electronic data processing equipment for commercial applications in America and was the first railroad to program and place freight revenue accounting on a computer. Visitors have come from many other railroads and from foreign countries to observe Southern's IBM 705 installation in Atlanta.

SOUTHERN'S APPROACH TO ELECTRONICS

In spite of extensive utilisation of punched card and electro-mechanical bookkeeping equipment, Southern in 1954 was faced with an unmanageable growth rate in clerical costs.

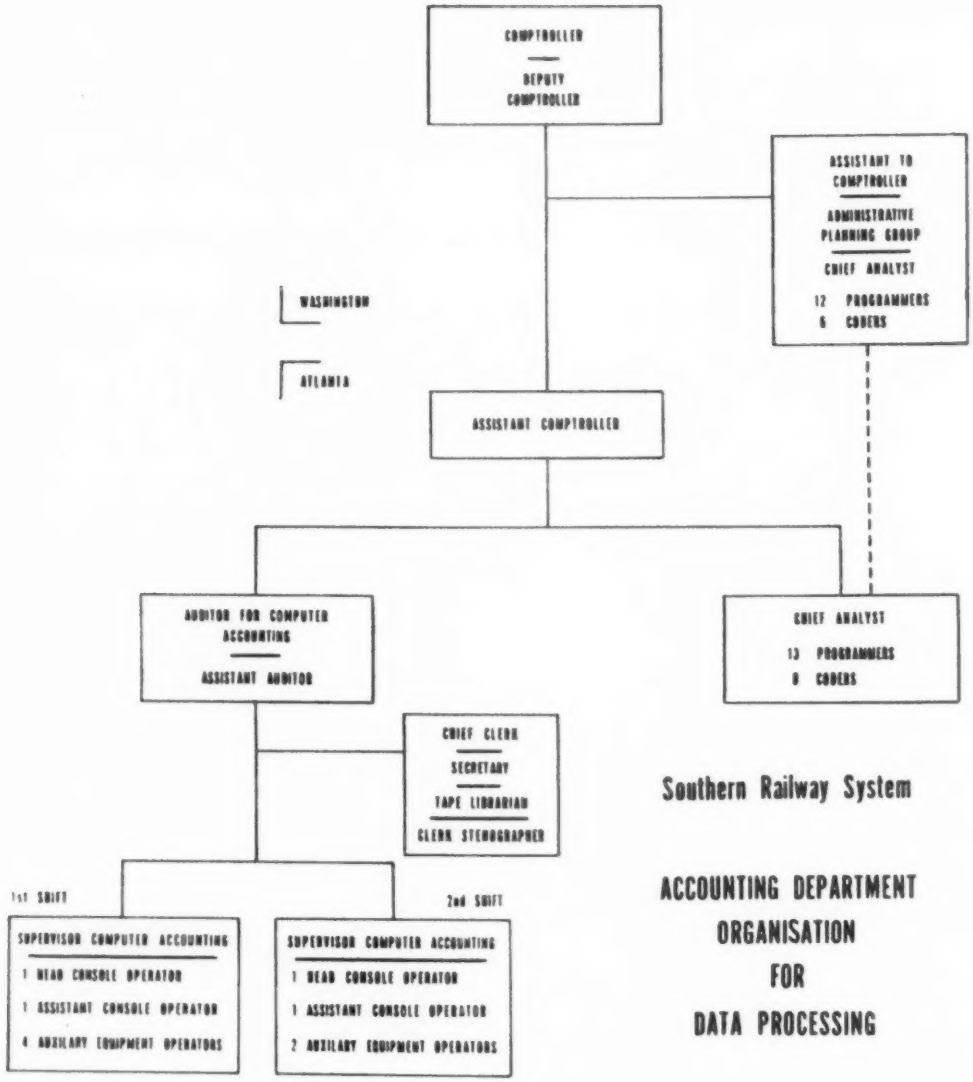
The Accounting Department employed over 1,400 people and more than 900 were occupied with freight revenue accounting alone. Pre-war minimum clerical costs had been about four dollars per person per day, but after the war they began to go up, and have since risen 350 percent to $18 per day.

The need to accommodate a larger volume of data with improved accuracy and speed, together with zooming clerical costs, presented the railway with a dilemma which caused management to welcome the possibilities offered by electronic computers. As one accounting manager with 20 years' experience in freight document processing observed: 'We had for years been searching for a machine that would do the "complete job" and along came the computer—the first machine we could even hope might present an answer.'

KEY QUESTIONS

The possibility of utilising an electronic computer for railway accounting was first suggested at Southern in June, 1954. The Controller and his planning staff addressed themselves directly to two key questions:

1. Are electronic computers really capable of processing business data?
2. Does Southern Railway have a paperwork



Southern Railway System

ACCOUNTING DEPARTMENT ORGANISATION FOR DATA PROCESSING

problem which is suitable for successful data processing?

The studies made by various industry groups at that time seemed to be of little assistance in helping Southern to evaluate the impact of electronic data processing on the transportation industry. However, two telltale indicators were orders for computers placed by the Chesapeake and Ohio Railroad and by the Interstate Commerce Commission.

The answer to the second question seemed to be clear merely on the basis of the size of Southern's clerical force and the sheer mass of paper work currently being performed. And, since much of this work was highly repetitive, it appeared to be highly suitable for electronic processing. The study group concluded that electronic computation should be feasible in seven of the railway's major paper work categories:

1. Commodity shipment recording

2. Freight rate verification
3. Interline freight revenue divisions
4. Freight car movement recording
5. Passenger revenue accounting and ticket auditing
6. Payroll
7. Government reporting.

EQUIPMENT SELECTION

Satisfied with Southern's need for an electronic computer, the study group set out to decide which machine could do the job best. An initial decision to instal an IBM 702 was made; an IBM 650 was installed to begin on the problems of freight revenue accounting 'during the waiting period. When the 702 was superseded by the 705 in late 1954, Southern reassessed their plans and decided to delay further to take advantage of the later model.

Southern received its computer—the first delivery of a 40,000 storage position 705 to any customer—in December 1956.

A detailed listing of the components of Southern's 705 installation is given in the table below:

LIST OF COMPUTER COMPONENTS
Southern Railway Systems

	COMPONENT	QUANTITY	MONTHLY RENTAL
705-II	Central Processing Unit	1	$14,150
745-I	Central Processing Unit Power	1	1,200
782-I	Console	1	1,000
727-I	Magnetic Tapes	21	11,550
777	Tape Record Co-ordinator	2	6,800
714	Card Reader	1	1,500
759	Card Reader Control	1	900
720	Printer	2	2,800
760-I	Printer Control	2	5,000
774-III	Tape Data Selector	1	2,500
747-I	Tape Data Selector Power	1	500
407	Printer	1	875
519	Card Punch	1	210

Figure 1

SELECTION AND TRAINING OF PERSONNEL

As Assistant Comptroller Mr Robert Curry was appointed to direct the planning of the data processing system installation.

Under Mr Curry's direction, aptitude and intelligence examinations were administered to nearly 900 employees to select individuals for training during the next two and a half years. Many of these trainees were later dropped from the computer program because 'school performance sometimes clearly indicated lack of sufficient abilities to cope with computer planning and operation.' Figure 2 illustrates the extent of the training program undertaken by Southern.

COMPUTER INSTALLATION TRAINING PROGRAMME
Southern Railway System

COURSE	NUMBER OF PEOPLE ATTENDING
Equipment Operators' School	63
Coding School	17
Programming School	55
EAM Schools, Key Punch and Wiring	46
IBM Supervisory and Executive Courses	20
University Courses	17
Management Courses and Seminars	48

Figure 2

In retrospect, Mr Curry would suggest an even more extensive utilisation of preliminary personnel testing before selection, but is quite firm in his belief that the policy of carrying out planning and programming by Southern personnel was much better than bringing in outside personnel or relying completely on the manufacturer.

The diagram opposite shows Southern's accounting department organisation for data processing.

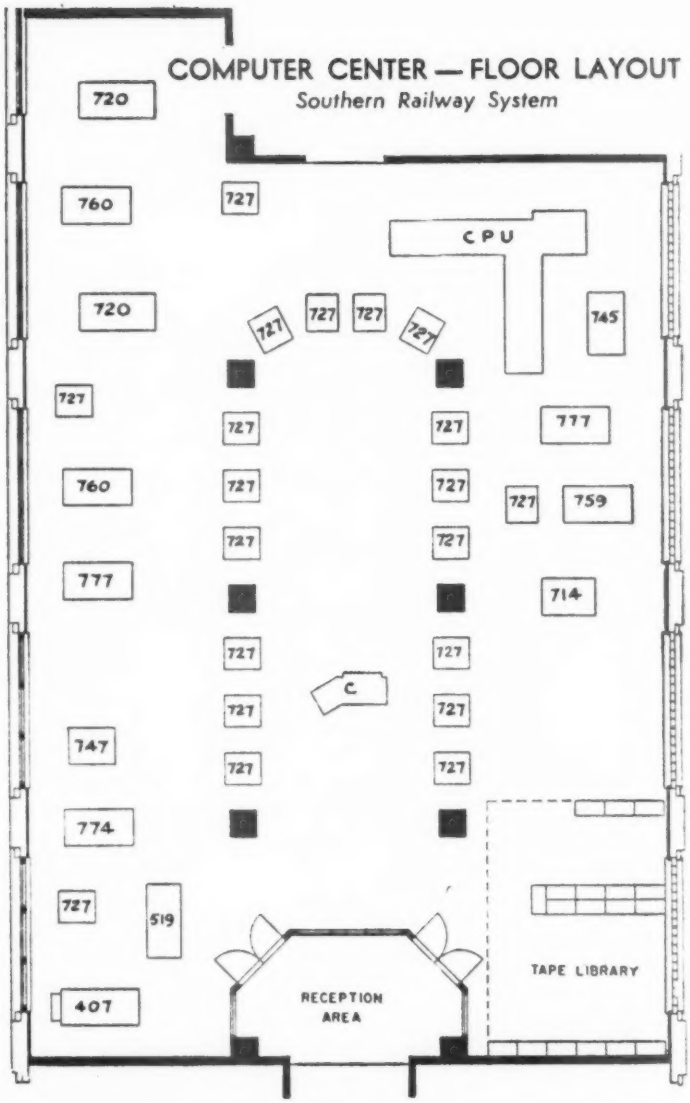
PROGRAMMING

Immediately following the preliminary selection

From the console of Southern's data processing department. [The layout of the department and the equipment are illustrated graphically on page 30.]

KEY:
to the system

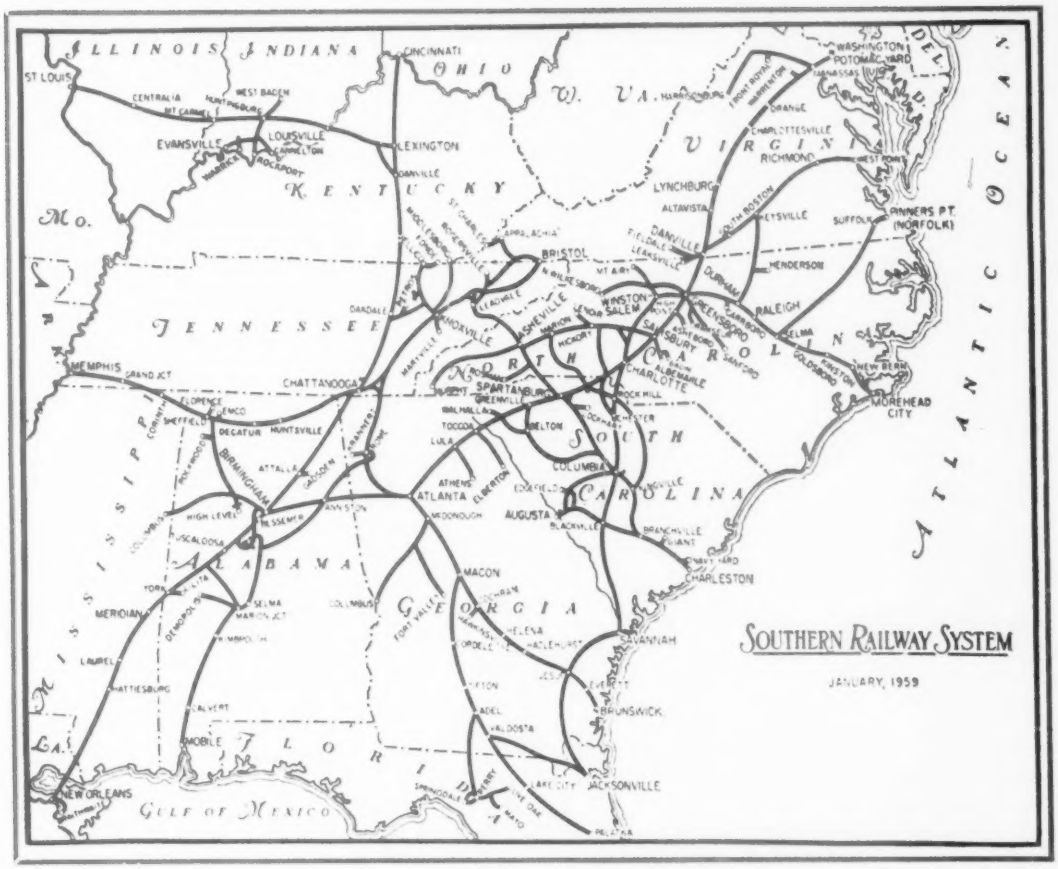
720	printer
760	printer control
727	tape units
777	TRC (tape control)
747	power unit
774	TDS
519	card punch
407	printer
745	power unit
759	reader control
714	card reader
C	console
CPU	central processing unit



and training of personnel, 650 programming was begun for the freight revenue accounting applications. By the time that computer was installed in July 1955, five large program blocks had been completed and successfully tested at IBM's Endicott computer facilities.

The bulk of the programming effort was carried by three individuals who had successfully completed the selection and training program. Two of these were former chief clerks with some college training and a thorough familiarity with freight accounting but with no experience in punched card work. The third man was also a former clerk who was particularly familiar with management reports and statistical analysis. This three-man team had the benefit of continuous close support from an IBM 650 specialist.

Concurrent with the 650 program, systems work and flow charting had been carried on for the 705 installation. This large-scale machine was turned over to Southern in December 1956, and the first production run was accomplished in January 1957. At that time, programs had been completed for processing portions of freight revenue accounting, station accounting, traffic statistics, and a 4,000-employee office payroll.



The main arteries of Southern's railway network.

The initial 705 programming effort extended over a twelve-month period, with an estimated 25 man years of effort involved.

Southern calculates that its direct programming costs for this period were approximately $160,000. Perhaps more significantly, Southern considers the programming effort as a never-ending one. In this regard, Southern has already run into the conflict that arises when one must decide whether to devote available programming strength to the improvement of existing programs or to the programming of new applications. For the present, ADP management is building a catalogue of all possible improvements, but is concentrating attention on preparing new applications for the computer.

FREIGHT REVENUE ACCOUNTING

To appreciate the voluminous paperwork problems that beset the railroads, one must consider the extensive transportation system of the United States and the number of different companies involved in most rail shipments. The majority of freight shipments are carried by several different railroads, and the destination railway (the railway handling the final part of the road movement) is responsible for collection of money from the recipient for the transportation services rendered by all railways involved in the interline haul, except in cases of prepaid shipments. The destination railway must then compute freight charges according to a very complicated rate and tariff structure, and distribute the revenues among the participating carriers. Such settlements among the railroads are made on a monthly basis and are contained in an 'Interline Statement.' Approximately 85 percent of all of Southern's freight traffic consists of such interline shipments.

The initial step in the freight revenue accounting procedure takes place in the railway office when the station agent accepts a shipment from the consignor and prepares a bill of lading which is the shipping contract. The station agent also

prepares a waybill for each shipment which provides necessary shipping instructions. It lists names and addresses of consignor and consignee, forwarding and receiving stations, freight car initial and number, description and weight of the commodities contained in the shipment, freight rate, handling instructions, charges, etc. This waybill accompanies the shipment to its final destination where the station agent prepares a freight bill which serves to notify the consignees of the shipment's arrival and of necessary collection charges.

The original waybill and one copy of the freight bill are submitted to a central accounting bureau of the destination railway where the waybills are reconciled with the freight bills and sent to the data processing centre.

WAYBILL DATA

Data contained in the waybills are processed to obtain reports pertaining to such items as: current charges to each agent's account, collected and prepaid; list of all agent's daily reports; list of items settled by agents; statement of unpaid freight bills; analysis of an accounting for corrections made by agents; report of individual miscellaneous accounts; statement of each agent's monthly account.

Daily interline reports are created from the same data and are later co-ordinated for end-of-month settlement and revenue distribution with the participating railways.

Waybill data are also used in the preparation of internal traffic reports and a variety of government reports including: total station tonnage and earnings for the month, branch line earnings, mortgaged or leased line earnings, taxable earnings by state, tons per mile and revenue by states and system, monthly and quarterly commodity reports, comparative traffic statements, traffic destiny statements, etc.

Under Southern's former method of accounting with conventional punched card machines, a card was cut from the freight bill for reconciliation with the waybills, thus utilising the information on the freight bill to establish the debit in the agent's account. A card was also prepared from the cash transactions listed on the cashbook, and a second balance or reconciliation was made between the cash transactions and the amounts established in the agent's account.

OPERATION OF IBM 705

With the 705 the freight bills are now filed upon receipt in the central office, and only the waybill is utilised as a source document in all phases of station and cash accounting. The machine automatically adds the freight and advanced charges, deducts the prepaid, and thus establishes the net debit to the agent's account. This debit becomes the accrued amount of the agent and the only balance against this figure is through the cash program.

Cards having been cut from the cash transactions and converted to tape are reconciled or audited against the tape carrying the accrued debits to the agent's account.

The station and cash accounting is thus performed with only one balance between the original document, the freight waybill, and the so-called cash drawer or cash deposits of the agency.

In this fashion Southern has eliminated the freight bill from audit office accounting, thereby effecting a dramatic revision in station and cash accounting procedures which now rely only on original and final documents: the waybill originating at the origin point and the cash collected at destination.

By introducing this system change, Southern has eliminated approximately 350,000 freight bills from its monthly audit office accounting operations.

EVALUATION OF SOUTHERN'S ADP PROGRAMME

After more than a year of operation, Southern is a very satisfied 705 user. This is primarily due to the actual financial and management benefits that have been obtained through computer usage. Southern officials strongly point out two facts:

1. The 705 is a valuable management tool. It is now providing, as a by-product of standard accounting operations, timely management information that could not be obtained previously.

2. The 705 is producing financial savings. One year after installation the system was operating at an annual rate of computer savings at $850,000. This figure is net, and includes all planning and programming costs as well as the net increase in machine rental costs and the construction costs of the Computer Center (amortised over a five-year period).

Some time before the 705 was installed, Southern's president was questioned about the additional cost of some $50,000 per month that was about to be incurred. He responded by saying: 'Well, they tell me it will more than save its cost when it gets going, and—it had better get going or I'll save it at a lot faster rate by eliminating the salaries of the officers who recommended it.'

As proof of the success of electronic data processing at Southern, Mr Curry is still in office to offer the following advice from his experience:

1. Do not merely transfer a previously mechanised procedure to the computer.

2. Planning input data and scheduling output data are more than 50 percent of the job.

Masses and Managers

The following extracts are taken from an article* which appeared in *The Times Literary Supplement* of 18 December 1959 and are here reprinted by special permission. The article was referred to in 'Comment' in the January 1960 issue of AUTOMATIC DATA PROCESSING

THE masses we have always with us, but in our era alone has the word 'mass' been used of civilisation. We began this century with mass-production, only to pass to mass-consumption, and so to mass-criteria for the arts, politics, international affairs, and even ancient social institutions like family relationships, law, religion and social administration.

. . . . . .

Our era is one of masses, then; yet they are either tyrannised by totalitarians or un- or mis-managed by democrats; shoved from behind by despots, or un- or mis-led by democratic 'leaders.' It does not seem, in the democracies at any rate, to be the masses' fault. Since Attic days these masses have not changed their spots. They have greater powers and authority, but it is doubtful whether they have greater knowledge how to rule themselves. The failure lies in the arts of human management and the managers of the masses.

. . . . . .

Powers of leadership which used to be required only of specialist leaders to cope with abnormalities or emergencies—war, sin, crime—are in modern societies required generally to cope with day-to-day normalities, and all the time. In Britain we have recently been making public exhibition of our lack of them. What we have also publicly exhibited is our unconcern about this lack of leadership. It is putting a costly premium on an old, cosy, familiar way of life, in a world that has no use for it, and in which it is of no use to us either.

The big changes in society which make it 'modern'—and make it seem so admirable to the leaders of societies less industrialised—are due to mass-application of 'scientific' discoveries. *Caveat* Socialists! Commercial exploitation of such inventions has proved highly popular with the masses. Business is what has made society modern and enjoyable for the masses, not economics, and not politicians. The more modern societies have become, the bigger have businesses become. Bigness of business is even more the hallmark of Russia than of America. That is, the organisation of the citizens in working time—now reduced in America to one-third, and in Britain to two-fifths, of waking time—has become a function not of man-power but of capital—or machine-power.

The masses everywhere show that they want to benefit materially by businessmen's translation of inventions into productive realities. They have certainly shown, even beyond the Curtain, that they prefer better products than those of the State. They accept bigness. What they do not see, and what few have dared to tell them, is that to

realise their wants they *must* obey—not the bosses, who are, as they ever were, human, but the exigencies of the machine, the factory, the business organisation, the process, the scientific discovery's own principles. Today's human bosses are only interpreters of these exigencies. To behave in 1959 as men behaved in the year of Brunel's death a century before, or in the days of Adam Smith a century before that, is as stupid as trying to navigate the new France with a crew of a caique.

RESPONSIBILITY FOR LEADERSHIP

This is appreciated by the 'toiling masses' of America in their trade unions, and of Russia without any effective unions; of France, Germany and Japan. The 'toiling masses' of our own country and their leaders hardly yet seem to have become aware of it. And who are the leaders who should have told them? Not the trade union leaders, both unofficial and official, but those other leaders on whose shoulders on both sides of the Curtain the responsibility of business management rests: the managers, from chairman to foreman. That is where responsibility for leadership in business lies, where it has always lain, and where it always will. If it could ever lie anywhere else it would mean anarchy; which is why the Russian leaders of the masses and of business maintain industrial law and managerial order by force.

Human work is only one of many elements in modern production. In old-time production, on or off the land, it was well-nigh all. Today it is less important in production than ever, and bids fair to become even less so. This may seem a hard saying. It is, however, only a statement of fact. It is not a statement that *human beings*, especially in workplaces, are less important than machines or capital; or that managers should consider the latter more than the former. It is a challenge to our thinking about our workplaces and human relations inside them, like the recent article in *The Times* (October 30, 1959), 'What's all right for Jack?' It is the biggest challenge of all to politicians and to business managers.

. . . . . .

The magnitude of mis-diagnosis in our industrial relationships can be gauged from the disarray inside our trade unions and the equal disarray inside managements. Their combined result is an increasing tension and inefficiency in British workplaces. It bodes ill for us all.

Who is to mass the masses, who is to manage the managers? The step to asking that question is short. It has already been taken, very near us—in France. If a Parliament could manage all these things, we would become a totalitarian democracy in Dr Talmon's meaning of the term. Since it cannot, responsibility for production of our material welfare will, we hope, remain with the management of private enterprises. But in that case, management must correctly diagnose the troubles of industrial society, accept primary responsibility (while others accept secondary responsibilities) for putting them right, and even help our trade unions to become efficient (eg. by employment of many more permanent, younger, well-paid officials). This would help to make the modern workplace more satisfying for human beings whose work becomes briefer and less onerous, and also more productive because the fixed capital would then be allowed to work to the full, and bear most of the stresses and strains of human work—except only those of management!

. . . . . .

From the businessmen's side . . . there have been failures to keep abreast of the big changes in society . . . They have preserved too long the illusory comfort of ivory towers. Business, the Stock Exchange, 'the City,' 'the board room,' even 'the office,'' have all been preserves for syndicates of the elect . . . A notable few, mainly in Big Business—oil, chemical and engineering firms, and the London Stock Exchange—have decently and objectively cultured 'public relations.' A few firms and the banks have also cultivated their own employees' understanding of modern problems (not only those of the business concerned) and nourished it by modern media of communication—books, films, trips, discussions. But the great mass of British businesses and business men—and, be it admitted, of their shareholders—faced with such a need to improve their employees' understanding of modern life, or to improve the human relationships in workplaces, are still prone first to ask 'What's in it for us?' This degree of economic myopia, political indifference and financial parsimony is typical of the *average* British business. Just so are waste of work-time and consequent low productivity typical of the average British business compared with American and other modern standards of management. The mass of an iceberg, like its danger, is not in the obvious, visible top; it lies below.

At the 1959 national conference of the British Institute of Management in November, Lord Baillieu, President of the BIM, declared that the outstanding new problem in this era of change was the *increasing rate of application* of new knowledge, techniques, methods and apparatus in *all* sectors of the economy. It is no new thought among the minority of thinkers among management in America and Britain, though its recognition as outstanding among problems is widening. The British veteran and *decanus*

emeritus of the thinking minority is Lt-Col L F Urwick, who can find no comfort in re-reading his own words to the same effect just after the first world war. In season and out, he has waged what was for many years only a two-handed struggle, but is now many-handed, for recognition of our need to provide formal instruction of a long-term kind in the teachable elements of management (as they have long and successfully done at the Harvard, Wharton, and other 'business schools' in the United States), but linked to practical training by the experience of management in many places.

NEED FOR TRAINING

On the nearby Continent there has been since 1949 a rapid rise of institutions . . . to do this, particularly as proportions of 'the masses' (manual workers and clerical office workers) fall, but of the 'new manageriate' (trained white-collar workers) rise, with capital apparatus doing more and more of the work. But things do not move fast here. The BIM itself, and one or two other places of formal but short-term course-giving, like the Administrative Staff College, remain small, thinly staffed and financed, bravely battling against that massive indifference of average managements above. Portuguese, Italians, French, Germans strongly support American-like institutions of management training. Their British counterparts merrily help an Institute of Directors to plunge into short-run political battles but will not support any long-run activities to raise management's own efficiency and striking power . . . As the American Mr Peter Drucker remarks about Big Business management: 'the past is going fast . . . the new can already be discerned . . . it is a time in which no one can take for granted the world he lives in.' What is implied for the New Managers by the abruptness of technical progress today?

Mr Drucker emphasises a point often overlooked. The so-called professional, technical, administrative, and managerial group of the working population in an advanced nation today is the biggest. It is the group of new skills. It is growing, and will grow more. It is also the youngest. On the other hand the proportion of manual workers has been sinking for decades—all this century; and although trade unions include millions of white-collar workers . . . the average age of trade unionists today is higher than it was decades ago, or even before the war, and is rising, both in America and here. In America, managerial techniques lead the world and trade unions are most extensively equipped with well-paid officials of high training in managerial techniques. The average age on the bosses' side of the American bargaining table before the war used to be 20 years older than that of the younger union men opposite them. Today the position is reversed: it is the union representatives who are 20 years older. Much the same is occurring here, notably in the older basic industries, some of which are now nationalised: coalmining, railways.

STRESSES OF MANAGEMENT

The responsibilities of management today are so manifold and complex, change so swiftly, and impose such stresses on managers, that the traditional British easy-going complacency and cosiness are black marks against any firm or institution manifesting them . . . There are all too many such firms here. The black marks are most evident in the smaller, family concerns, though recognisable in some large private enterprises which are not very enterprising and are becoming, in consequence, less private.

. . . . . .

Teamwork becomes more crucial as new techniques are applied to production. But if management fails to get teamwork, it fails altogether, for without it the production cannot possibly justify the new and increasingly complex techniques, which are themselves more costly, and must be more rapidly written off, than ever before. And why should not British *management* compete with 'official' leaders of trade unions for the shop stewards' teamwork? Why should not bosses and shop stewards work out productive solutions profitable to all, when unions fail to? It has been done in America.

Nearly all the books on management emphasise teamwork, continuity, freedom from strikes. It is a problem that cannot become less important or less acute save by its successful solution by management itself; for technical progress brings *more complex* teamwork.

. . . . . .

What *makes* a good manager? *Can* he be made at all? The answer is certainly not that he is born, even if poets are. A poet may sing unaided; but a manager cannot manage unaided; and what he has more and more to manage is mechanical, continuous, complex capital equipment and apparatus of great cost. More and more he has to manage it with conservative, slow-changing, emotional human beings, of improving skills and knowledge, but only of very slowly improving understanding of their world. So the good manager more and more must become the leader of a highly sensitive, intricate team whose teamwork must be flexible, and which as a whole spells success only if well led.

Lt-Col Urwick makes this point admirably in his 1955 lectures on the pattern of management at the School of Business Administration in the

University of Minnesota. He makes it to even better purpose, and in its proper context of leadership, in his 1955 lectures at the Regent Street Polytechnic at the invitation of its Management Association. Sub-average businessmen who like to think of business leadership as being 'simply' like that in an army, 'where men obey orders,' may with profit remember that no officer can command men on operations until he has shown proof of capacity to do so by tests of his training. They may also care to remember that the armed forces—unlike industry—train their own 'masses' not only in the use of their equipment but also to understand the world about them, and a lot of other things. Just as tests and training cannot make a good officer out of poor human material, training *and* experience together —not *either* the one *or* the other—cannot make a good manager, either out of a first-class scientist or a first-class humanist, if he is incapable of earning respect as a leader of men. Such respect is shown by willing followship—more, historically, in England than anywhere else—the outcome being effective and efficient teamwork.

Thus what *is* pre-required in human material for management is character, calibre, fibre; not mere 'poisonality.' And that prerequisite of good management—as of all leadership—cannot be taught to, or instilled into, an adult. This is neither the time nor the place to go beyond that statement, since it would take us beyond the British management problem into another equally grave: that of our children's education and of their upbringing in their families. Yet thus deep do our gravest social problems of today and tomorrow go.

WHAT OF TOMORROW?

What of tomorrow's managers? Well, our 'masses' are disappearing as such—at least, as masses of undifferentiated human workers. The once so-called working class is well-nigh gone. When there is no more human work—when the only real work done is by machines, by pieces of capital, which only require of human beings direction and supervision—what will the masses be then? They will be directors and supervisors. We shall all be managers, then. 'We shall all be changed.' But we shall remain human. Our grave social problems—of education, politics, crime and law and order, leadership and followship hierarchies and their human relations and their teamwork—will remain. They may well be even graver. Who, then, will mass the masses, or manage the managers? There is still time to think. But, to judge by signs of the times, not much.

National Information Centre on Automatic Programming

A NATIONAL Centre of Information on Automatic Programming of Digital Computers has been established by the department of mathematics of Brighton Technical College, in response to a recommendation of the first national conference on automatic programming, held in Brighton in April of last year. This conference was attended by 111 delegates from computer manufacturers, industrial and commercial computer users, government research establishments, universities and technical colleges.

The purpose of the centre is to establish and maintain a comprehensive library of publications, papers, research reports and other material, especially material that is not readily accessible, in any way relevant to the problems of automatic programming, and to make these available on demand, in English.

The centre will also publish an annual review of automatic programming and provide a clearing house for information and enquiries. It will help to co-ordinate the work of other bodies active in the same field. It will organise small working conferences on particular aspects of automatic programming, and will keep permanent contact with organisations throughout the world.

ADVISORY COMMITTEE

An advisory committee has been formed to help the work of the centre. Its members are Dr A D Booth, Birkbeck College, University of London, Mr R A Brooker, University of Manchester, Mr P V Ellis, International Computers and Tabulators, Dr S Gill, Ferranti, Dr J Howlett, United Kingdom Atomic Energy Authority, Dr R J Ord-Smith, Standard Telephones and Cables,

Mr C Robinson, English Electric, Mr Christopher Strachey, Mr A E Taylor, Remington Rand Univac Division, Mr J H Wensley, Computer Developments, and Mr M Woodger, Mathematics Division, National Physical Laboratory.

Corresponding members of the advisory committee are Dr Grace Hopper, Remington Rand, USA, Dr L Luckaszewicz, Polish Academy of Sciences, and Professor H Rutishauer, Institute of Applied Mathematics, Zurich.

The Organising Secretary of the National Information Centre is Mr Richard Goodman, of the computing laboratory, Brighton Technical College. Miss Ethel Garratt is librarian.

In conjunction with Pergamon Press Limited, the centre publishes an *Annual Review in Automatic Programming*, and an occasional *Bulletin of Abstracts* is issued to members. An English translation of the Russian journal, *Problems of Cybernetics*, is also available to members at a reduced price.

Full information can be obtained from the organising secretary at Brighton Technical College, Brighton, Sussex.

Automatic Office Under Test

COMMISSIONING tests were carried out on the Leo 'Automatic Office' installed in the offices of the Ministry of Pensions and National Insurance, Newcastle, during November, and a report on these has just been issued by Leo Computers Ltd.

The tests were set by an expert body formed to advise government departments on technical standards of computers.

The tests were carried out on five consecutive days, 2 to 6 November, from 9.30 am to 5.30 pm on the first four days and from 9.30 am to 5.0 pm on the fifth day.

A series of nine tests was run respectively, five of them diagnostic test programs designed to examine exhaustively the correct functioning of all aspects of the equipment, and four of them actual programs taken from the payroll suite that is planned to be the first operational work taken over by the installation.

TIME TRIALS

The trials were controlled by Ministry members who had been trained by Leo Computers to operate the equipment. Careful notes were kept of loss of time due to faults in the equipment and that due to operating inefficiency, including faulty preparation of data.

The timing of the trials is shown in the table below :

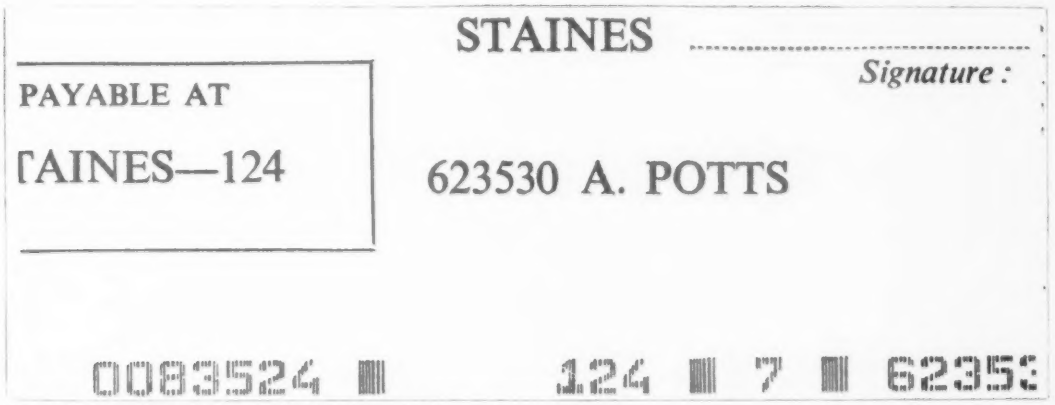
Good running time	37 hours	44 minutes
Time lost due to technical causes (including re-runs) ...	—	51 minutes
Time lost due to inefficient operation	—	54 minutes
Total	39 hours	29 minutes

Discounting the time lost through inefficient operation, the equipment achieved 97.8 percent good running time, which exceeded the standards looked for.

The equipment includes a Leo II computer with a 16,000-word magnetic drum and a 2,048-word highspeed store, three concurrent punched card input channels, with provision for a fourth, two punched card output channels and a printer output channel.

PROGRAMMING TEAM

The first routines were programmed concurrently with the building equipment. The programming team was formed mainly from the staff



Part of a cheque greatly magnified to show the form of numerals used in De La Rue Bull direct reading. Each character consists of seven lines of magnetic ink. (See page 38.)

of the Ministry and trained by Leo Computers, who have accepted responsibility for the successful completion of the work. The programming has been supervised by a senior programmer from Leo Computers.

SALARIES AND WAGES

Early programs include the payment of 20,000 monthly salaried staff throughout the United Kingdom and 3,000 weekly paid staff at Newcastle, the production of analysed health statistics from accident and sickness records, and the control of the issue and receipt of National Insurance claims.

Magnetic Characters

A VARIANT of magnetic ink characters has been introduced to Britain by De La Rue Bull Machines Ltd. Of the three styles of character so far made public, these differ least from normal type faces.

Each figure is made up of a series of seven vertical lines, spaced either 0.2 millimetres or 0.4 millimetres apart. The basis of the reading system is that the magnetic ink appearing in the vertical lines is simply an alerting signal to the reading equipment, and the actual interpretation of the figures depends on the dispositions of the narrow and wide spaces.

(The vertical lines also differ in thickness, but this is for 'aesthetic' reasons and has no effect on the reading process.)

The normal numerical code is obtained by using seven vertical lines, giving six spaces, of which two are wide and four are narrow. The spaces between different figures are great enough for the reading apparatus to turn itself off, and a quick-acting delay mechanism allows six spaces to be read before the interpreted figure code is transmitted for subsequent data processing or for direct recording. The same principle can be applied to the reading of alphabetical information.

Certain advantages are claimed for this system. For example, less accuracy of printing is necessary than with magnetic profiles; and the system is rapid because the signal obtained from the vertical lines and spaces can be translated directly into a binary signal.

The system was demonstrated in Paris to the Conference of European Bankers in October, when cheques were sorted according to various sorting codes and account numbers. Though a number of cheques were deliberately defaced and damaged no single error was detected in the reading of 'a vast number' of sorting codes, account numbers and amounts.

Information Retrieval

ALLEN KENT, associate director of the centre for documentation and communication research at Western Reserve University, Cleveland, Ohio, USA, has been appointed by the University and the National Science Foundation in the United States to undertake an investigation into procedures for the automatic searching of literature on metallurgy. A grant of $159,200 has been made available for the project.

James W Perry, director of the centre for documentation and communication research, said that the grant would enable the centre to extend its operations into many scientific fields pertaining to metallurgy.

Mr Kent will design his evaluating program on the University's GE-250, a highspeed prototype of the WRU Searching Selector, now under development. It is estimated that documents will be searched at the rate of 100,000 an hour.

First public utility in Southern California to adopt an electronic computer to handle its customer billing is Southern California Edison Company, which has announced plans to install a Honeywell 800 in its new Long Beach, California building. Pictured signing the contract are Walter Finke (left), president, Datamatic Division, Minneapolis-Honeywell; and T. M. McDaniel Jr., vice-president, Southern California Edison. Billing of 1,000,000 of Edison's 1,600,000 customers will be handled by the computer starting in early 1961. Edison also plans to use the system for engineering processing.

Pegasus for Assurance Company

THE London and Manchester Assurance Company Limited have placed an order for a Pegasus electronic data processing system, worth £100,000, with Ferranti Ltd.

The equipment is to be installed at the London headquarters of the assurance company in October. It will be used first for the company's ordinary branch accounting and valuation work.

The Pegasus will be programmed to prepare premium renewal notices, to control payments and

to do the agency and company accounting, and the annual valuation of all the company's life assurance policies. Programs are now being written and will be largely proved on the machine before delivery. A unified card file, using ICT equipment, has already been installed.

Three other Ferranti computers have been bought by insurance companies—two in Sweden and one in South Africa—but this is the first sale to a British insurance company.

All the TV in China

ONE of the latest models of EMI's colour television cameras has been shipped to China, with control equipment and a Rank-Cintel large-screen colour projector, forming a complete closed-circuit installation. It is the first colour television equipment to be exported to China by a British company.

This colour camera is designed especially for a wide range of industrial, scientific and medical uses, as well as for broadcast studio work. The optical system has been designed so that the maximum amount of light falls on the photoconductive surfaces of the vidicon tubes, giving better quality reproduction under poor lighting conditions.

ICT Sales to France

THREE French companies have ordered ICT 1202 computers. Etablissements Thibaud Gibbs Fragim et Cie, of Paris, manufacturers of toilet preparations, propose to use their machine for invoicing, sales accounting, stock control, vehicle loading and payroll.

Crédit Agricole, an important organisation specialising in agricultural finance, will use the 1202 for interest calculation and other banking tasks.

Insurance accounting, statistics, premium advice notes and other routines will be done on the machine to be supplied to a large insurance company, La Cité Vie, of Strasbourg.

These are the first orders from the Continent for the ICT 1202, but they encourage the belief that there is a considerable European market for medium sized general-purpose computers of this type.

The Short Simlac

THE name 'Simlac' has been adopted by Short Brothers and Harland Limited as the trade mark of the new range of general-purpose computers that they are now developing.

The Short Simlac has been specially designed by the precision engineering division of the company to deal with the problems of modern science, including nuclear kinetics. It is claimed for it that it sets new standards of reliability and accuracy.

The Simlac incorporates new wiring techniques and patching system, eliminating 'cord clutter.' The flexible push-button selector system and problem check represent an advance on current standards in the field of analogue computers.

Changes in the United States and Canadian dollar rates are now indicated to members of the London Stock Exchange on an automatic indicator. This system, installed early in January, replaced the traditional information system—a man, a stool, a blackboard and a piece of chalk. The indicator was supplied by Setright Registers Limited, of Hackney Wick, London, E 9

International Conference on Medical Electronics

THE third international conference on medical electronics is to be held at Olympia in July. It is being organised by the electronics and communications section of the Institution of Electrical Engineers, Savoy Place, London, WC2.

Doctors, biologists and electronic engineers from all over the world are being invited to attend. The proceedings are designed to appeal not only to medical and electronic specialists but also to those who wish to get a general background to the many new techniques.

The advance of electronics in medicine is very rapid. Electronic techniques and instruments are being used to measure the velocity of respiration, the excretion of carbon dioxide in the breath and the depth of anæsthesia during surgical operations. They are also being used to measure and to control automatically the breathing of patients partially paralysed by poliomyelitis.

It is expected that new methods of measurement and control, affecting diagnostic techniques and treatment of illness, will emerge from the conference.

Computer for Ilford

ILFORD Limited, manufacturers of photographic equipment, have ordered a Leo IIC computer, to be used for payroll, invoicing, stock control, sales analysis and production planning.

The company supplies its 30,000 customers from stocks held in depôts throughout Britain, and the effective control of these stocks is one of the main advantages that Ilford expect from the computer.

The total assembly, costing approximately £250,000, will include the Leo IIC with immediate access magnetic core store, two large auxiliary drum stores, paper tape and punched card input, and magnetic tape, card and highspeed printer output.

* * *

Allen V Astin: RESEARCH, INSTRUMENTATION, AUTOMATIC ANALYSIS AND RESPONSE. *Computers and Automation. Vol. 8, No. 11. November 1959* (USA).

INSTRUMENTATION has a profound effect upon technical advance. It is fundamental to physical measurement and hence to observation and experiment. An instrument of increased accuracy can give rise to new concepts, which in turn demand new instruments.

Instrumentation is the common denominator of scientific research and technology. 'Electronic instrumentation clearly demonstrates this. Electronic instruments have come to be of service both in experimental laboratories where careful observation and adjustment are necessary and also in industrial plants where continuous observation and control are important.'

The bright prospects for automation in industry are a direct result of phenomenal advances in electronics, which bring 'the exciting possibility of the full force of "feedback" as a practical principle in automatic control.' Feedback is an extension of the idea of communication—between man and machine, and even between machine and machine.

Petroleum production, with automatic measurement, refinement and processing control, and modern flour milling are two examples of the feedback principle applied in industry.

* * *

E M Zaitzeff and *M M Astrahan:* RUSSIAN VISIT TO US COMPUTERS. *Communications of the ACM. Vol. 2, No. 11. November 1959* (USA)

AMERICAN and Russian computer experts exchanged visits in April and May of 1959. 'Negotiations' began in 1957 and got under way in October of 1958, when Mr Astrahan, in answer to his invitation to the Russian Academy of Sciences received a cable: 'Not only was it in Russian, but also the Russian characters had been transliterated into English, complete with transmission errors . . .'

In spite of this, seven Russian delegates arrived in New York on 18 April. They were taken to a New York hotel where they discussed their itinerary and then invited their hosts to a caviar and vodka party in one of the hotel rooms.

After one of the Russian delegates had lost a briefcase containing several bottles of vodka and some caviar in a New York taxicab, the party visited the IBM plant at Poughkeepsie, where the Russians were most interested in a magnetic core matrix, in the reliability of IBM machines and in the interchangeability of tape.

The visitors were questioned on developments in Russia and explained that very little was being done there on machine learning, but theoretical research into the problems of language translation was progressing with the purpose of constructing a special machine.

The Russians were also taken to the Massachusetts Institute of Technology, Harvard University, the University of Pennsylvania in Philadelphia, the National Bureau of Standards and the Bureau of Census in Washington, the naval proving grounds at Dahlgren, Virginia, the Federal Aviation Agency (where they said they didn't have air traffic problems in Russia) and the Bureau of Patents.

COURSES AND LECTURES

18 February
Lecture on 'The Development of the Use of a Computer for Production Control'
Organised by The British Computer Society
Venue: Northampton College of Advanced Technology, St John Street, London, EC1.
Enquiries to: S A Tasker, Esq, Office Manager, The British Computer Society Ltd, Finsbury Court, Finsbury Pavement, London, EC2.

22 February-4 March
Course on the IBM 650 (Basic) Computer
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

22 February-4 March
Course on the IBM 604 Calculator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

22 February-4 March
Course on the IBM 421 Accounting Machine
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

23-26 February
General Appreciation Course on Computers
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

23 February
Talk on 'The Payroll Application at Newton Chambers & Co Ltd'
Organised by The British Computer Society
Venue: Mathematical Institute, University of Liverpool
Enquiries to: A J Platt, Esq, Honorary Secretary, The British Computer Society, c/o Pilkington Brothers Ltd, St Helens, Lancs.

25 February
Lecture on 'Basic Principles of Programming'
Organised by The British Computer Society
Venue: Small Shanlon Lecture Theatre, University College, Cardiff
Enquiries to: Mervyn Thomas, Esq, 4 Park Road, Hengoed, Glam.

26-28 February
Introductory Weekend Computer Course
Organised by The Institute of Cost and Works Accountants
Venue: Westham House, Barford, Nr Warwick.

29 February
Seminar on Operational Research
Organised by British Institute of Management
Venue: Newcastle
Enquiries to: The Conference Secretary, B I M, 80 Fetter Lane, London, EC4.

29 February-4 March
Instruction Course for the IBM 088 Collator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

29 February-4 March
Introductory Course to the IBM 088 Collator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

29 February-11 March
Course on the IBM 305 Ramac Computer
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

1 March
Seminar on Communication
Organised by British Institute of Management
Venue: London
Enquiries to: The Conference Secretary, B I M, 80 Fetter Lane, London, EC4.

1-11 March
Introductory Course on Computers
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

2 March at 6.30 pm.
Talk on 'The Application of a Computer on the Determination of Least Cost Mixes in the Animal Feeding Industry'
Organised by The British Computer Society
Venue: University Computing Laboratory, Eldon Hall, Woodhouse Lane, Leeds
Enquiries to: Dr A S Douglas, Electronic Computing Laboratory, The University, Leeds, 2.

3 March
Talk on 'The Royal Army Pay Corps Computer Application'
Organised by The British Computer Society
Venue: Manchester College of Science and Technology, Sackville Street, Manchester
Enquiries to: Capt C A Cox, Honorary Secretary, The British Computer Society, Industrial Administration Department, Manchester College of Science and Technology, Manchester 2.

7 March
Lecture on 'The Use of Computers in Operations Research'
Organised by The British Computer Society
Venue: Royal College of Science and Technology
Enquiries to: K D Henderson, Esq, Honorary Secretary, The British Computer Society, c/o J & P Coats Ltd, 155 St Vincent Street, Glasgow, C2.

7 March
Talk on 'The Computer and Monte Carlo Methods'
Organised by The British Computer Society
Venue: Constantine Technical College, Borough Road
Enquiries to: W A Greig, Esq, Honorary Secretary, The British Computer Society, Constantine Technical College, Borough Road, Middlesbrough, Yorks.

7-18 March
Course on the IBM 626 Calculator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

7-18 March
Course on the IBM 604 Calculator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

7-18 March
Course on the IBM 421 Accounting Machine
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

7-18 March
Course on the Mercury Computer
Organised by Ferranti Ltd
Fee: £30
Venue: Ferranti Ltd, Portland Place, London, W1.

8 March
Talk on 'The Computer and Monte Carlo Methods'
Organised by The British Computer Society
Venue: University Computing Laboratory, 1 Kensington Terrace
Enquiries to: W F Mason, Honorary Secretary, c/o National Coal Board, GPO Box 10, Cathedral Buildings, Dean Street, Newcastle-upon-Tyne 1.

8-18 March
Introductory Course on Computers
Organised by IBM (United Kingdom) Ltd
Venue Wigmore Street, London, W1.

9 March
Talk on 'The Staff and Organisation of a Computer Department'
Organised by The British Computer Society
Venue: Hull Chamber of Commerce, Samman House, Bowlalley Lane, Hull
Enquiries to: J Gemmell, Esq, 15 Stanhope Ave, Holderness Road, Hull.

9 March
Seminar on Production Control in the Smaller Company
Organised by British Institute of Management
Venue: Birmingham
Enquiries to: The Conference Secretary, B I M, 80 Fetter Lane, London, EC4.

14-18 March
Introductory course for the IBM 088 Collator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

14-18 March
Programming and Instruction on the Application and Use of Electronic Controlled Machine Tools
Organised by EMI Electronics Ltd
Fee: 10 guineas
Venue: EMI Electronics Ltd, Hayes, Middlesex.

14-25 March
Course on 'Additional Features to the IBM 650 Computer'
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

15 March
Lecture on 'Axis Transformation using Analogue Equipment'
Organised by The British Computer Society
Venue: Northampton College of Advanced Technology, St John Street, London, EC1
Enquiries to: S A Tasker, Esq, Office Manager, The British Computer Society, Finsbury Court, Finsbury Pavement, London, EC2.

17 March
Lecture on 'Data processing in Local Government'
Organised by The British Computer Society
Venue: Room 104, Leicester College of Technology
Enquiries to: E A Richards, Esq, 70 Carlton Drive, Wigsten Fields, Leicester.

21-25 March
Introductory Course for the IBM 088 Collator
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

21-25 March
Course on 'Practical Wiring'
Organised by IBM (United Kingdom) Ltd
Venue: Wigmore Street, London, W1.

21 March
Lecture on 'The Production Control Application at Letchworth'
Organised by The British Computer Society
Venue: Mathematical Institute, University of Liverpool
Enquiries to: A J Platt, Esq, Honorary Secretary, The British Computer Society, c/o Pilkington Brothers Ltd, St Helens, Lancs.

21-30 March
Programming Course on Ferranti Pegasus
Organised by The University of Southampton
Fee: £5 5s. 0d.
Venue: Southampton University
Enquiries to: The Director, Computation Laboratory, The University, Southampton.

CONFERENCES

9 March
Conference on Electronic Computers – Top Management Appraisal
Organised by British Institute of Management
Venue: Glasgow
Enquiries to: The Conference Secretary, B I M, 80 Fetter Lane, London, EC4.

11 March
One-day Conference on 'Statistical Methods in Plant Control'
Organised by the Bristol College of Technology
Fee: £2.2.0
Venue: Bristol College of Technology, Ashley Down, Bristol 7.

27-28 May
Conference on 'The Computing Laboratory in the Technical College'
Organised by Hatfield Technical College
Venue: Hatfield Technical College
Enquiries to: Head of Mathematics Department, Hatfield Technical College, Hatfield, Herts.

25 June-5 July
International Congress for Automatic Control
Organised by International Federation of Automatic Control (British Conference on Automation and Computation)
Venue: Moscow
Enquiries to: The Secretary, The Institution of Production Engineers, 10 Chesterfield Street, Mayfair, London, W1.

Storage Drums

A RANGE of magnetic storage drums is now in production at the two main factories of Sperry Gyroscope to meet the requirements of automatic telephone exchanges and the latest digital computers. Each type meets the most stringent specifications.

Magnetic storage drums—types A and B (the latter is of larger capacity) — developed in co-operation with Automatic Telephone and Electric Co Ltd for automatic telephone operation, but equally suitable for computer applications, are now coming off the assembly lines in increasing numbers to be delivered to GPO exchanges throughout Britain for the subscriber trunk dialling (STD) system.

A third type—type C units—are very much larger, and have been designed to meet the exacting requirements of computer manufacturers, in particular Standard Telephones and Cables Ltd.

Type C drums have been designed to provide a flexible range of storage assemblies at an economic cost. This is achieved by combinations of two standard sub-assemblies comprising a motorised drum unit and, in the case of larger capacity assemblies, multiples of slave drum units. All the units are coupled together to form a rigid cylindrical assembly with a common vertical spin axis, which is then shock-mounted in robust frameworks.

Both the motorised and slave units consist of a basic recording drum and head mounting mantle, with, in the case of the motorised unit only, a drive motor and eddy current braking disc. The construction of each unit is such that it is virtually sealed to prevent the ingress of foreign matter which would otherwise collect around the magnetic heads.

Each drum is surrounded by a mantle drilled to a standard pattern of head-mounting positions, affording a variety of single, double and multiple head tracks. The motorised unit also contains a 3-phase inverted squirrel-cage motor wound for a line voltage of 190 volts (unless otherwise specified), and incorporating class B insulation.

Each complete drum assembly is provided with a common solenoid operated pump unit supplying metered quantities of lubricating oil from a reservoir to each of the drum bearings. The solenoid is operated at frequent intervals by an outside electrical supply. In the unlikely event of the oil supply failing, the alarm system incorporated in the pump unit closes a pair of normally open contacts to operate any suitable warning device.

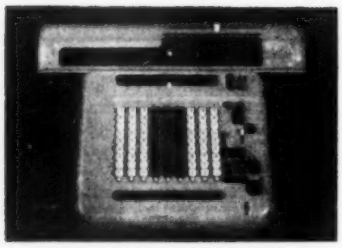
Drums can be supplied with either nickel or oxide recording surfaces.

Sperry Gyroscope Co Ltd,
Great West Road,
Brentford, Middlesex.

New Range of Calculating Machines

A RANGE of automatic desk calculating machines for which it is claimed that, by utilising a short-cutting system of calculating, their output is 50 percent

Above: a machine operator boring holes into a type C drum. Left: magnetic storage drums of type A and B undergoing final tests. Complete assemblies are run for periods of 10 days or more, during which vibration analyses are carried out.



faster than that of the conventional machine has recently been launched by the Archimedes Diehl Machine Company.

Features of these new machines include special checking registers to ensure faultless entry of figures, and a fully automatic multiplication from a single keyboard with self-explanatory 'multiply' and 'equals' keys.

Archimedes Diehl Calculating Machine Co Ltd.
Chandos House,
Buckingham Gate,
London, SW1.

New Marketing Arrangements

THE Swedish Addo-X range of electric book-keeping and accounting machines will in future be marketed by Remington Rand as well as by Bulmer's Business Machines Ltd.

For Missiles and Aircraft

A PROTOTYPE of a 'sub-miniature data magnetic tape flight recorder' was shown by Royston Instruments at the Physical Society Exhibition held in London last month. Developed primarily for use in missiles, the system would also provide a very small and compact multichannel tape transport mechanism for

FINISHING touches being given to a new high-speed magnetic tape drive which the Datamatic Division of Minneapolis-Honeywell recently demonstrated for the first time in Boston.

Capable of reading or recording 96,000 decimal digits a second, the unit is claimed to be the most efficient tape handling system yet devised. Use of an all-vacuum instead of mechanical drive is expected virtually to eliminate damage to magnetic tapes, and increase their 'life-expectancy' several times over. The new drive is to be used in the Honeywell 800 computers currently being built, the first of which will be delivered in October 1960.

other purposes. The tape is on spools mounted in a reloadable cassette which also contains the mechanical take-up, supply spool drives and tape tensioning. This has the advantage that no drive of any sort is required to the cassette and its position is not critical.

The dimensions of the unit are 4½ inches by 5½ inches by 3 inches and the tape capacity is 500 feet, which allows for an adequate recording time for most purposes, even at relatively high tape speeds. The recorder can be supplied with tape speeds anywhere in the range of 30 inches per second to 1/10th of an inch per second and normally provides for the recording of eight channels in line on a single head. Power consumption is approximately 5 watts and the weight of the unit with an armoured steel cassette is approximately 16 lb. With a light alloy cassette, strong enough to withstand arduous conditions, the weight is only 11 lb.

Another exhibit at the exhibition was a 'combined spool magnetic tape playback unit with additional continuous loop.' This instrument is intended to serve as a means for re-presenting a single sample in a repetitive form for continuous analysis, whilst retaining full facilities for editing and normal playback. A tape recorded at any speed may be replayed, viewed and edited, either on pens or on an oscilloscope and re-recorded on a continuous loop which is operated from the same capstan as the spool transport. This system has the advantage of avoiding the duplication of errors due to flutter. The tape is then replayed at 100 inches a second so that, irrespective of the tape speed and input frequency range of the original recording, there is a repetitive output with frequencies covering a range of zero to 10,000 C/s. In addition, a pulse is obtained for each revolution of the loop.

This equipment may then be followed by a normal laboratory-type wave analyser if the relatively large errors, due to the fact that the pass band of such analysers is not normally rectangular, can be tolerated; or alternatively, a switched filter unit followed by an integrator can be provided to work in conjunction.

Two models which form part of the company's Midas comprehensive routine flight data recording system were also shown at the exhibition.

The Midas system provides a complete, accurate and permanent record of every important operating parameter throughout the whole life of an aircraft. Speeded up automatic data processing permits the record to be translated into a compact, edited and useful form.

The two units in this system are a 'miniature cassette loading routine flight data recorder using magnetic tape' and a 'line maintenance magnetic tape playback equipment.'

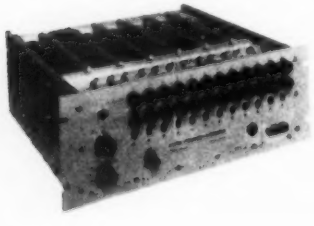
Royston Instruments Ltd.
Byfleet, Surrey.

Non-linear Function Generator

A DIODE function generator (coded type TR 829) has recently been produced by Solartron. Mounted in a standard 19-inch rack the unit will generate precise functions of a variable to a high degree of accuracy and stability. It is complementary to the existing range of Solartron precision non-linear analogue computing units.

The required function is generated in 12 segments, and the unit is simply set up by adjusting break points for each segment against a digital voltmeter monitor. These adjustments are made on high-resolution helical potentiometers, over the voltage range from zero to plus or minus 100 volts.

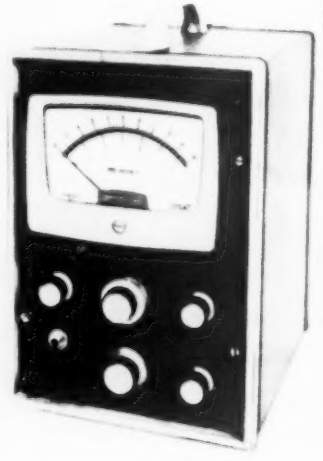
Incorporating a total of 14 high-gain DC amplifiers the generator does not require additional operational amplifiers to provide full output.



Solartron Electronic Group Ltd.
45 Thames Street,
Kingston, Surrey.

Analogue Frequency Meter

A TRANSISTORISED analogue frequency meter (coded Type TSA501) — a direct reading frequency measuring instrument — has recently been developed. It



covers a range of 3 C/s to 300 Kc/s in 10 steps — each range being capable of expansion by three or 10. Extra damping of the meter is available on the lower ranges. Accuracy is largely independent of the input waveform.

The instrument is capable of measuring frequencies whose amplitude may vary from 200 mV RMS to 250 volts RMS for sine wave, or from 0.5 volts peak to 500 volts peak for pulse waveform.

By using in conjunction with the TSA501 a combined photohead and light source instrument (coded TS22) the speed of a rotating shaft or wheel may be measured. A socket at the rear provides the necessary power supply and signal lines to a TS22 unit.

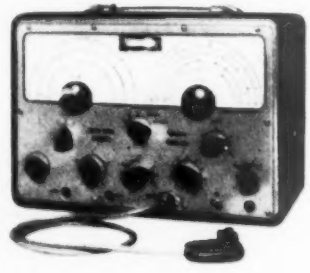
A remote indicator or recorder may also be used with the TSA501 via a further socket at the rear.

The instrument can operate from an internal 12-volt battery, an external battery or from the mains.

Venner Electronics Ltd.
Kingston By Pass,
New Malden, Surrey.

New Signal Generator

A SIGNAL generator designed mainly for the servicing of AM and FM high frequency receivers and the intercarrier IF stages of television receivers has been developed by Taylor Electrical Instruments. Model 61A (as the generator is designated) provides in conjunction with an oscilloscope, complete facilities for the sweep alignment of the RF, IF and discriminator or ratio detector stages of AM or FM receivers.



Covering the range 4-120 mc/s in five bands, all on fundamentals, the AM generator has a calibration accuracy of plus or minus one per cent and a modulation of 35 per cent at 400 C/s.

The FM and sweep section also operates on fundamentals, avoiding the confusion and poor frequency inherent in the frequency difference method. The FM and sweep bands cover the frequencies 4-12 Mc/s and 70-120 Mc/s in three bands, and the FM generator has a calibration accuracy of plus or minus two percent.

Deviation on FM is variable up to 100 Kc/s from the mean carrier frequency at a modulation rate of 400 C/s. The sweep covers a total band width of one Mc/s at power line frequency. A crystal calibrator circuit with a switch selection of any one of three internally mounted crystals, is incorporated.

Taylor Electrical Instruments Ltd.
Montrose Avenue,
Slough, Bucks.

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SHORT COURSE IN OPERATIONAL RESEARCH

The London School of Economics and Political Science will hold a further course in Operational Research, from 28 March to 8 April, 1960, for graduates or persons with equivalent qualifications and suitable experience. Limited residential accommodation will be available and fees will be £65 including residence or £50 non-resident. Particulars and application forms can be obtained from the Registrar, The London School of Economics and Political Science, Houghton Street, Aldwych, London, W.C.2. The last date for the return of completed application forms is March 9.

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The successful candidate will be given an opportunity to gain experience on other than maintenance work, including programming.

Applicants should possess qualifications leading to Graduate Membership of the Institution of Electrical Engineers and/or have had considerable computer maintenance experience.

Salary on a scale within the range £900-£1,350 p.a. according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary to the Personnel Officer, 24-30 Holborn, London, E.C.1, as soon as possible. Envelopes should be marked Confidential Ref. ADP/5.

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E.M.I. Electronics Ltd. have vacancies for experienced Computer Programmers to join their expanding EMIDEC 1100 and EMIDEC 2400 team. Applicants should have had programming experience of either scientific or commercial work. They will be concerned with the commercial applications of the computers and thorough training will be given. These posts carry very good starting salary and excellent prospects.

Please write, quoting Ref. ET 13 P, to:

Personnel Manager,

E.M.I. ELECTRONICS LTD.,
HAYES, MIDDLESEX

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De La Rue Bull Machines Limited requires Servicing Engineers who will be responsible for the installation and maintenance of their complete range of electronic computers and electro-mechanical data processing machines.

Applicants, who should be between the ages of 25 and 40 years, should have a sound background of electronics and light electro-mechanical engineering gained through study, preferably to Higher National or "A" level G.C.E. standard, and through experience in industry or the Armed Forces.

A knowledge of French will be an advantage.

Successful candidates will be required to attend a short course in French in the U.K. followed by six months' technical training in Paris. Thereafter employment will be in customers' establishments in the U.K. and organised on a regional basis. Where possible engineers will be located near their homes.

Salary will be £750-£950 per annum according to qualifications and experience. Appropriate allowances will be paid to cover lodging expenses during training period. There is an excellent pension scheme.

Candidates short listed for interview will be required to take a simple competitive written test in electro-mechanical engineering and also a short practical test. These will be held early in March.

Applications, stating full details of age, education, qualifications and experience to **Assistant Personnel Officer, The De La Rue Company Limited, 84-86 Regent Street, London, W.1.**

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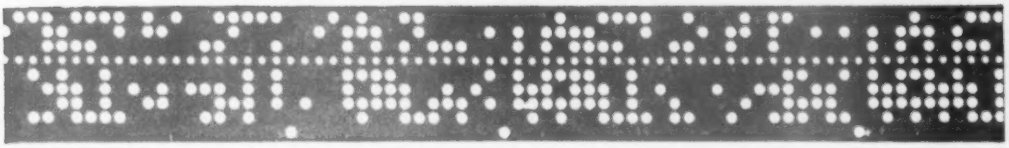
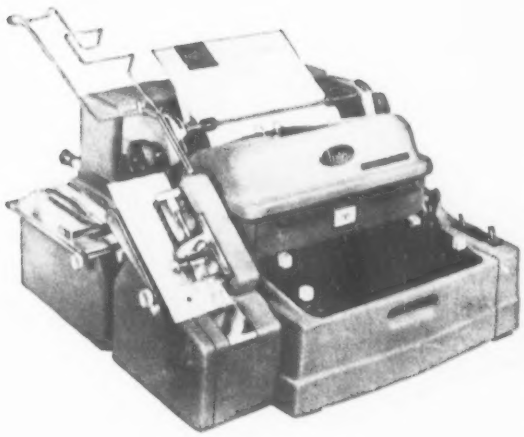
FRIDEN FLEXOWRITER



does your sales order-invoicing automatically



Speeds and streamlines work routines

Eliminates human errors

Saves time and money

The FLEXOWRITER is an automatic machine which produces a code-punched tape as a by-product of writing the original document. This punched tape is then used to create other records automatically, eliminating the continuous manual reprocessing of data that runs up office costs.

For example, the punched tape produced as an automatic by-product of a sales order automatically prepares the sales invoice, and punches cards for statistical reports. Purchase orders, goods received notes and many other records may be prepared with similar advantages.

The FLEXOWRITER may be installed one at a time, in multiple units or in connection with auxiliary equipment, thus greatly expanding its applications.

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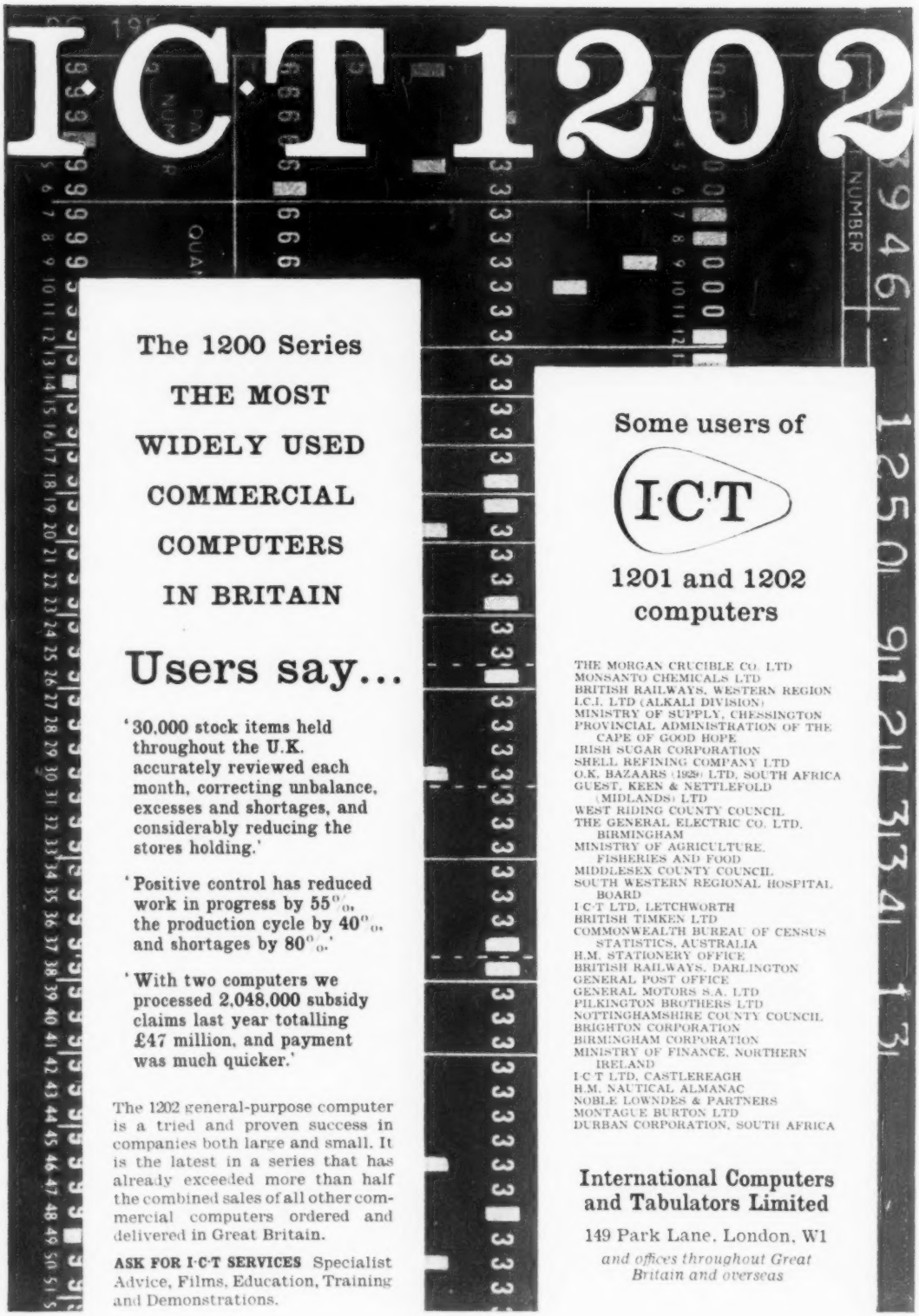

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'With two computers we processed 2,048,000 subsidy claims last year totalling £47 million, and payment was much quicker.'

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